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AN AGRICULTURAL REVIEW FOR 1917.

The year 1917 has presented many problems to the agriculturists of the Colony. The exchange difficulties which began at the latter part of 1916 have continued throughout the year and the majority of agricultural undertakings have had to give serious thought to the finance of their operations. Tea and rubber companies have had to pay their dividends in sterling drafts and have found difficulty in selling their produce locally except against drafts on London.

Owing to the shortage of freight and a limitation of the imports of tea into the United Kingdom, most estates found it necessary to restrict their output to some extent during the year but in the last few months more freight for tea offered. Tea was during the last months of the year taken under control in the United Kingdom by the Food Controller, and arrangements made for the purchase of Ceylon teas in London and in the Colony on Government account.

Rubber has not experienced such difficulty in freight and, despite a fall in price towards the end of the year, rubber estates have been able to carry on as usual. There have been some difficulties over manures and over local sales for cash, but these have been met and overcome. Diseases of rubber still receive close attention on the majority of estates, but the necessity of an adequate inspectorate force for the control of pests and diseases has been dealt with during the year. A bark disease, new to Ceylon, has recently been found in the drier districts and is under investigation.

Coconuts and coconut products have suffered severely during the year. Very little freight has offered, and coconut owners have seen prices, in spite of high values in Europe, of their produce gradually fall until they, at the end of the year,

are barely above the cost of production. Continuous efforts have been made to relieve the situation, but with the shortage of tonnage no solution of the difficulty has been possible. It is feared that many smaller properties will be unable to carry on at present prices, but it is gratifying to record that all larger properties are endeavouring to carry on their cultivation programmes as far as possible as usual and are utilizing poonac largely in their manurial mixtures. A new disease of coconuts has come to light during the year in the Kurunegala district, but latest reports indicate that it is limited to a comparatively small area.

Cinnamon products were unsaleable until the last months of the year, and citronella grass continues to be replaced by other products.

Early in the year, it became evident that strenuous efforts should be made to encourage the greater production of food stuffs in the Colony. A gratifying response to the appeals for an increased planting of food products, curry stuffs and vegetables was made by all classes of the agricultural community, and a record distribution of seed and planting material was carried out. This important question cannot however be left with this distribution, and preparations are now being made for further efforts with the South-West monsoon in June next. The difficulties of the railway over coal should emphasize the necessity for this production of a greater amount of food products in all parts of the Colony. The formation of district food-production committees has been suggested, and one such committee has already begun operations. There is no doubt that such bodies can do much to assist in the food-production problem.

Deliberations have been carried on throughout the year over the question of the development of lands in the Dry Zone, and the report of the Committee has been favourably received. The Government have undertaken to make funds available for the formation of peasant settlements.

An increase in the number of agricultural instructors has been made during the year, and further demonstration gardens opened up. The organization of a series of such gardens throughout the Colony will be carried on as funds become available as there is little doubt that through them the agricultural methods of the villager can be improved.

CEYLON AGRICULTURE.

LAND DEVELOPMENT IN THE DRY ZONE.

At the meeting of the Ceylon Agricultural Society on the 26th November, 1917, the following discussion took place on the Report of the Land Development Committee which was issued as a Supplement to the November issue of the journal:—

LAND DEVELOPMENT COMMITTEE'S REPORT.

MR. STOCKDALE in submitting the report of the Land Development Committee of the Ceylon Agricultural Society said : " This Committee was appointed in 1916 to go into the question and consider the development of lands under tanks in the Dry Zone. It has had eleven meetings and its report is submitted to the Society to-day. The recommendations of the Committee comprise its views as to how development can take place and it recommends for the consideration of the Society whether peasant settlement could not be established under Nachchaduwa tank. Notes in respect to those proposals are printed as Annexure I. From that annexure you will see an initial expenditure of about Rs. 6,000 would be necessary. A further sum would be required next year to enable settlers to open up further lands. The Committee has considered several tank schemes and has decided upon Nachchaduwa tank as offering the best prospects for immediate success, because it is near Anuradhapura. The question of communications, markets for settlers would be assured. Several others have been considered and the Committee decided upon the Nachchaduwa Scheme. Further schemes would be considered if this one be successful. It was urged that the Committee should consider the settlement of Tamils under another tank and a settlement for Moors under another, but in the first instance they consider that a settlement of Sinhalese under the tank at Nachchaduwa should be tried.

MR. BALASINGHAM'S REMARKS.

The HON. MR. BALASINGHAM said :—I wish to make a few observations on the report of this Land Development Committee. With much that is said there I am in complete agreement. But there are one or two points on which I beg to differ. I agree with SIR CHRISTOFFEL'S dissent on the subject of leases. I do not understand why the Committee thinks that the leasing system is the best means of assuring land development. When it was understood that the Government was contemplating the discontinuance of sales and introducing a system of leaseholds, the few who welcomed it, welcomed it on the ground that it was a splendid thing for the poor. It is now admitted by everybody, and even by this Committee, that freeholds are more attractive to men with moderate or little or no means. In fact, the best means of attracting the poor man is to offer land on the hire-purchase system and to spread out the payment of price over 30 or 40 years. Any condition that may be attached to leases as to cultivation may be attached to such sales. I fear that the Committee's recommendation is on behalf of the rich capitalist. This Committee was appointed at the annual meeting in 1916 as a result of the following observation in the annual report of this Society on the subject of cultivation of

lands under tanks. The annual report for 1916 said :—" What is to be desired—at least as an initial measure—is that these lands should be given at nominal rates to individual capitalists or syndicates on the condition that a certain proportion of the area is brought under cultivation every year. We have waited long enough for colonisation by small settlers." This present Committee reports that paddy cultivation does not appeal to the capitalists under present conditions : that tank areas can be more rapidly developed by lcapitalists ; that capitalists should be allowed to cultivate coconut and other like products; that capitalists will be interested only if they can secure land in large blocks for development upon estate lines; that for coconut cultivation 250 acres would be the minimum area that could be worked economically and it makes its recommendations accordingly. On what facts are these recommendations based ? Is it a fact as was stated in the annual report of this Society for 1916, that we have waited in vain long enough for colonisation by the small settler? I think, Sir, it is not the small settler but the capitalist that has failed. The report of this very Committee shows that the small settler had very little encouragement in the past. We have not established State Banks for aiding the man without capital on the security of his land and produce as in Australia or New Zealand. We have not provided medical aid to protect the small settler against malaria. We sell lands by the auction system under which the poor man has no chance as against the capitalist. Then again, Sir, coconut is a product for which there is still plenty of land by the sea board and it is not necessary to give the lands under the tanks " at a nominal rate to capitalists" for the purpose of coconut cultivation. If the capitalists will pay a fair share of the cost of construction, say even half the cost of construction, there cannot be much objection to partitioning these tank areas into big estates. Paddy cultivation and the cultivation of other food products deserve some subsidy, and the money spent on our irrigation works is in the nature of a subsidy. Moreover, paddy cannot be successfully grown except under tanks or where there is a large rainfall ; but coconuts grow without irrigation even in the dry zone. Small plots of land may with advantage be put under coconuts in the tank districts, but I do not think that extensive cultivation of coconuts in the irrigable area on estate lines is a wise policy for the Government to adopt. The best method of encouraging the development of uncultivated land would be by imposing a higher Customs duty on such products as we can grow in this country. Onions and chillies, for instance, can be easily grown in this country. The duty on these may be raised. To guard against any possible hardship to the poor consumer, the duty on articles of food which cannot be easily grown here may be lowered or altogether abolished. Another means of encouraging development will be to appoint a Minister of Lands with Executive Council rank who will hold the portfolios of Irrigation, Agriculture, Forests, Land Sales, and Survey and Colonization. He will be able to co-ordinate the work of all these departments and give his whole time for the development of land. There can be no objection to lease if it is optional and freeholds are available.

DR. H. M. FERNANDO'S REMARKS.

The HON. DR. H. M. FERNANDO made some observations on MR. BALASINGHAM'S remarks. He feared that MR. BALASINGHAM was suffering from a serious misapprehension. In connection with the Committee's report, he said, that a year ago himself and SIR PONNAMBALAM moved for the appointment of

the Committee and the whole of the indictment against the report of 1916 in connection with the terms made for the development of tank irrigable lands had been met by the present Committee. They had gone into the whole question and every point raised by MR. BALASINGHAM had been met in the recommendations. As regards the leasing system they had not tried to upset any recommendations. In the matter of colonization the recommendations of the Lease Committee were quite plain and obvious. Holders of small blocks were actually given the land eventually as freehold, when the land had been properly developed. There was nothing in regard to small colonists that they cannot own property.

MR. BALASINGHAM : I am speaking of leaseholds.

DR. FERNANDO said that that was a different thing entirely. The observations of MR. BALASINGHAM would mean that under the colonization scheme the Committee recommended that holders of small blocks cannot be purchasers.

MR. BALASINGHAM : Not at all.

DR. FERNANDO continuing said that he differed from MR. BALASINGHAM. In the case of the Kalawewa Scheme, large blocks were held by capitalists, which had not been developed at all. it was very difficult to give these large blocks, which had been left undeveloped by the owners who had done nothing. In fact, in one case, a gentleman who owned 500 acres had never been to the site at all. That was a matter that had been fully met by the recommendations of the Committee. Finally, as regards the opportunity to be given for planting coconuts and other products in the irrigable area he was in sympathy with MR. BALASINGHAM. He did not think a case had been made out that other crops should be raised on irrigable areas. Until some scheme was carefully brought up that such lands could not be utilized with profit, they might leave the matter for the present. If irrigable paddy lands were treated properly and receive proper cultivation they would eventually become profitable. He felt sure the Director of Agriculture would be quite willing to make experimental tests on irrigable lands in various tank areas and show the cultivator how cultivation could be made to pay by improvements in the present methods. He personally felt certain that a large paddy growing industry would be put on a solid and successful basis. Then as increased encouragement to the growing of currystuff, etc., by protective duties, it was a very important question. Such a scheme cannot be lightly taken up. What did he mean by protective duty ? Did he imagine a few cents difference would turn the scale ? He feared that the protective duty would be a very big one and the whole fiscal system and Customs duties would have to be revised.

LEASEHOLD AND FREEHOLD.

The HON. SIR S. C. OBEYESEKERE said he was in sympathy with everything that MR. BALASINGHAM stated. Nobody should be debarred from purchasing land if he had the means to purchase it. Those who wished to lease land might do so, while others, who desired to purchase land, should be permitted to do so. Therefore, means should be provided for a man who wished to purchase land and was able to do so. There should be no interference and Government should not interpose in the way of a poor man becoming a proprietor. Supposing a man obtained a ninety-nine years' lease and he wished to make his will and leave it to his descendants how could he do it, if he held the land on lease ? There would be very few people who would like to be in that position. He (the speaker) for one would like it, had he the money to invest.

CRUSADE AGAINST CAPITALISTS.

SIR P. ARUNACHALAM said that DR. FERNANDO's arguments had not been met. Personally he felt that capitalists were given too great privileges and advantages. He should like to see a law restricting the amount of land capitalists could hold. As regards the poor man, the scheme put forward by the Committee provided sufficiently for him. Blocks under ten acres would be made available for small capitalists on a leasing system, with subsequent rights to freehold after development. Under the Colonization scheme, too, they got blocks under ten acres subject to certain conditions after development. It was very reasonable. As regards the big capitalists, it was said SIR COOMARASAMY once said the system of selling land was prejudicial to the interests of the country, as it was making away with the capital of the country.

SIR S. C. OBEYESEKERE said that with regard to the remarks about capitalists that there were few purchasers who were not in a position to colonize the lands they had purchased owing to various reasons, such as the want of dispensaries, medical wants, etc. Without such aids it was rather difficult, but once provision was made there would be a rush to the lands.

REMARKS BY LIEUT.-COL. JAYAWARDENE.

LIEUT.-COL. T. G. JAYAWARDENE said: In reading through this very interesting and able report one could not help coming to the conclusion that the cause for the slow development of land under the irrigation tanks are mainly due to: (1). Want of a settled Government policy regarding the disposal of the Crown lands; (2). Want of properly constructed roads; (3). Want of adequate medical aid; and (4). Want of sufficient encouragement and assistance from Government. The want of a fixed policy on the part of Government is fatal to the development of any scheme whatever. There should be a settled Government policy, and a continuity of that policy. Once that is established, no Government Agent or Irrigation Officer, or any other Head of a Department should be allowed to interfere with that policy, just to suit his own whim or fancy. Government should make up its mind as to what it is going to do with the land; and declare its intention to the public. The policy of Government should be finally settled, and conditions of sale or lease widely published. I see from the paper now before us that several applications have been made from time to time for land under the tanks. Application has been made some years ago by a syndicate for an extensive track under Nachchaduwa. But the applicants were informed that it was inadmissible to allow one extensive block to large capitalists, and the proposal fell through. Again, about a year ago, an application was made by two Colombo capitalists, for 1,000 acres under Nachchaduwa. They were told that 500 acres could be given, and that also after the block survey, which had not been completed. It is also stated that when an application is made for the sale or leasing of Crown land, the matter is referred to the Irrigation Department who are in the first place unable to definitely state whether the lot selected would fall within the irrigable area; and if they think that it is likely to come within that area, then the application is promptly refused. These are serious statements to make against a Government Department, but under a settled and declared policy charges of this kind are bound to disappear. Government has at the back of its head the object of colonising these lands by means of peasant settlers. A very worthy object indeed, and we should wish it all success, for a happy and contented peasantry is the backbone of a

country. Government is also, perhaps, anxious that any land once taken up by the small settler should not be alienated by him in favour of the large capitalist and Company promoter. It could not, therefore, do better than copy the Punjab Land Alienation Act of 1900 which, from all accounts, has worked wonders in the Punjab State. Then as regards roads.—No colonisation on any large scale is possible without properly constructed roads. We do not want fair weather roads, or mere tracts which are only apologies for roads. Properly constructed roads are necessary to make the lands better accessible and for the carting of produce. I am sure we all agree with the Government Agent who said that roads should not become impassable for vehicular traffic in wet weather. It is just at this time that sickness is chiefly prevalent, and good roads become of importance for the purpose of getting people to hospitals and dispensaries. As regards medical aid—a mere dispensary, with a stock of quinine powders and with no other medicine than for malarial cases is worse than useless. The G A., N.C.P., says dispensaries will not suffice ; hospital control is necessary to effect much improvement, especially in the case of parangi. I think all agree with that. A good doctor is also a *sine qua non*. Want of sufficient encouragement and assistance from Government.—Now, I come to the thorny question. We all know the benevolent intentions of Government towards the country's peasantry : with what good intentions the Waste Lands Ordinance was enacted, although it has not been worked with due sympathy in all cases. How solicitous Government Agents of the type of the late MR. IEVERS, and MESSRS. FREEMAN and BARTLETT of the present day, are over the true interests of poor peasants in their provinces.

But Government, I am afraid, has been most seriously unmindful of the interests of the paddy cultivator under Tissamaharama Tank in the Southern Province and the reports of MESSRS. CORLETT and DRIEBERG make painful reading. This, I say, is a serious lack of encouragement and assistance on the part of Government. I trust that it is only an isolated case. Now, to return to the report of the Committee,—I think SIR CHRISTOFFEL OBEYESEKERE is somewhat unnecessarily alarmed. Although a Government Agent of the E. P. has given uncertainty of tenure, i.e. lands held on lease, as one of the reasons for the failure to make settlement in lands under Irrigation Works less attractive to the small cultivator, I do not think SIR CHRISTOFFEL OBEYESEKERE'S fears about people being debarred from purchasing the freehold of any block is quite well founded. If he reads para 2 sec. 7 he will see that the Committee view with sympathy the desire of every *bona fide* settler to own his own land eventually, and they make their recommendations in paras 2 and 3 of sec. 15 to satisfy that natural desire. I am, however, not in full agreement with the Committee when it tries to prohibit alienation of land except to members of the settlement, or their descendants. If it is to be a perpetual prohibition, it would, I think, be quite unfair. I do not mind having it continued up to, say, the 3rd or 4th generation. For, with the turn of the wheel of life, the descendants of the settlers of to-day may, perhaps, be more interested in these now wild parts than the descendants of the upper ten of the present day. Now, regarding the proposals for the establishment of a peasant settlement under Nachchaduwa and the estimated cost for a settlement of 25 families.—According to GUNESEKERA APPUHAMY, to aswedumise jungle it costs Rs. 80 per acre. So that it will cost Rs. 400 per

family (5 acres) or Rs. 10,000 for the whole 25 families, but you are only giving them Rs. 3,625 for the six months (as per items 3, 4, 6 and 7), provision has, I find, been made for buffaloes. The Hunumulla teacher says that he brought 25 acres under cultivation and that he had 10 buffaloes for cultivation work. He had purchased them in the locality at Rs. 30 or Rs. 40 each. These animals were not sufficient; he needed 4 or 5 head more. On this basis each family will require three buffaloes to cultivate its 5 acres or 75 buffaloes for the whole settlement which at Rs. 40 would come to Rs. 3,000. I do not see any provision for holding a dispensary or for sinking wells for drinking water. If I might make a suggestion it would, I think, be well to give the Colonization Officer, who, I presume, will be the Superintendent of Irrigation in charge of the scheme, an assistant to make that assistant live close to the settlement. He should be able to share the same building with the dispenser or doctor. In conclusion our thanks are due to the Director of Agriculture and the Committee for the enormous trouble taken in this matter and the able and businesslike report before us. This ought to simplify matters for Government to a large extent who should now be able to adopt the recommendations in their entirety or with modification.

MR. TILLEKERATNA'S REMARKS.

The HON. MR. O. C. TILLEKERATNE said that the report before them was a very carefully considered and an eminently fair one. As regards the leasing system the Committee itself stated that capital was not tied up in land and was available for development purposes. But once the villagers got the idea—the erroneous idea—that the object of the land development scheme was that the lands were to be leased in perpetuity, they would never come forward. Their great object was to own their own land, be it how infinitesimal a sub-division of an acre.

SIR P. ARUNACHALAM: That is obvious. Blocks under ten acres are made available for small capitalists as freehold. That meets the case.

MR. TILLEKERATNE, continuing, said that the report contained Rs. 6,000 as capital outlay, but there was no indication of medical facilities, and that was necessary. It would be necessary to have hospitals and dispensaries as suggested by COL. JAYAWARDENE. Somewhere he found that once, some years ago, when several families were sent out, that some seventy people died of malarial fever ! That would be the worse way to popularize land settlement. Then about the land under the Tissa tank as pointed out by COL. JAYAWARDENE. The Yala sanctuary, which was at the disposal of the villagers as pasture land for their cattle, was a game sanctuary. It was quite a desirable thing to have a game sanctuary, but at the same time villagers have been deprived of their pasture land which they had used from time immemorial. It was not at all desirable to allow paddy lands to be converted into plantations of coconut and sugar-cane. The sooner they got the people to take to paddy cultivation, as it was long long ago, the better it would be, but they must not overlook the case of lands included under irrigable lands but subsequently found unirrigable. He was glad to find that the Forest Department officers were not to meddle with the settlers who were allowed to find their firewood and make use of the trees without interference. There was also reference to damage done by wild animals. He thought that some sort of firearms should be allowed to those people who went out as settlers. The

greatest want would be the water supply. There should also be a depôt for the settlers to bring their produce for disposal instead of their carrying pingo-loads of a few brinjals for miles for sale.

REMARKS BY MR. SENIOR WHITE.

MR. SENIOR WHITE said there were one or two points in the report he wished to refer to. Paragraph 6, section 5, stated that it was necessary that settlers should have outside employment during the non-cultivating seasons. They might be employed in burning jungle and other works in large blocks belonging to others. He suggested that chena cultivation be absolutely prohibited. Each man must be made to clear and cultivate his own block of land continuously. With regard to financial assistance to be given he wished to know whether it was only for the commencement of the scheme or all throughout.

MR. STOCKDALE : At the commencement of the scheme.

MR. WHITE, continuing, said in regard to paragraph 13, it was most essential that Irrigation officers should be placed in charge of the scheme. He must be a sympathetic person, not merely a tax-gatherer. In regard to the Nachchaduwa scheme, the officer in charge might live at Anuradhapura, unless an Arachchi was selected out of those in the settlement, but that would have the effect of that man's land being neglected. There ought to be a resident headman, as it was quite possible that in a settlement a man should be on the spot to settle petty disputes. In regard to the half acre round the building he believed that it was for the purpose of planting vegetables for food, but then the men would be growing vegetables in their block of land. That would give the opportunity of the usual mess round the hut. The huts should be somewhat like cooly lines but not all under one roof or back to back. There should be spaces between and these spaces should be cemented as there was no chance of disease and dirt.

MR. BALASINGHAM IN REPLY.

The HON. MR. BALASINGHAM, in replying, said that nobody made a point that under certain tanks lands were bought but undeveloped. What was there in the leasing system that would make that impossible and what was there in the sale system that could not make it impossible. If, under the leasing system, conditions were imposed that no purchaser was allowed to have the land undeveloped for a certain number of years, there was nothing whatever to prevent the purchase system to insist on the purchaser to bring under cultivation the land. As a matter of fact land in the Wanni was sold on the condition that if a portion of the land was not under cultivation within a prescribed period the land lapsed to the Crown.

RACIAL DISTINCTIONS.

The HON. MR. A. SAPAPATHY said he was not prepared to make any detailed remarks on the report as he received a copy only that morning. From the statement made by the Director of Agriculture it would appear that settlement in the tank regions was put down on a racial basis. Some were to be set apart for Sinhalese, others for Tamils, and some others for Moors. He wished to be enlightened on the subject and desired to know the reason which actuated the Committee to make such a recommendation, as he failed to see why any one of the indigenous population of the Island could not settle in the tank regions.

DIRECTOR OF AGRICULTURE REPLIES.

MR. STOCKDALE said that they had a very interesting discussion on the paper. He would take the opportunity of saying one or two words on the points raised. The point brought up by COL. JAYAWARDENE in regard to the terms of the Nachchaduwa scheme. He referred to the fact that Rs. 25 per acre was recommended for the first year on the land. It generally took time to *asweddumise* the land for paddy. The reason why that was done was that the first thing to be done was to cultivate chena crops on the land and gradually to *asweddumise* it, and prepare it for cultivation. For preparing chena land Rs. 25 was considered sufficient for an acre of land. In the second year it would be brought under irrigation and the third year improved. Also there was no provision made for buffaloes. In evidence taken it was learnt that it would be possible to obtain buffaloes round Nachchaduwa. It did not seem desirable therefore to be involved in a large outlay of capital, which might be lost by death of animals. The question of dispensaries and houses for the officers were matters entirely for the Government and not for any scheme. Therefore no provision was made for building dispensaries or houses. There was a good deal of discussion in regard to leasing or sales. The Committee went into it very thoroughly. Opposite views were held by various members of the Committee. It was felt that where land was required by capitalists means should be taken to provide for development. It was felt that development could also be done by means of settlers—possibly a peasant settlement. It was pointed out that the lease-holders would sooner or later have the freehold of the land. What the Committee particularly desired to prevent was that in the peasant settlement, the peasants going to the nearest boutique-keeper and obtaining advances with a view to alienation of the land. That was prohibited except to members of the settlement or their descendants. The question of racial basis, which the HON. MR. SAPAPATHY had alluded to, he was not responsible for the misunderstanding. The Committee had made no such report. They went into the question of the Nachchaduwa scheme as a beginning. Everything pointed to the fact that a peasant settlement of Low-country Sinhalese would be more likely to be a success there. The Committee felt that other schemes might possibly be fixed for the settlement by Tamils and Moors. The Association of Nachchaduwa with Anuradhapura made it appear to be more desirable that a settlement colony there should be Sinhalese. They had the assurance of some members of the Committee and others who gave evidence that they could obtain Low-country Sinhalese to settle at Nachchaduwa. He formally moved the adoption of the report by the Agricultural Society which if adopted would be submitted to Government for consideration.

MR. N. H. M. ABDUL CADER seconded.—Carried.

PROPOSALS FOR SHOWS.

The following Proposals for Agricultural Shows and Prize Competitions in 1918 were submitted to the Meeting of the Ceylon Agricultural Society on the 26th November, 1917, by the Organizing Vice-President :—

During the present financial year of the Society, a sum of Rs. 500/- was assigned for grants to Agricultural Shows. Of this Rs. 105·95 only has been spent in connection with the Poultry and Nuwera Eliya Shows and it is

unlikely that there will be further expenditure before the close of the Society's accounts at the end of December.

With a view to encouraging the cultivation of food products, vegetables and curry stuffs, I would suggest for your favourable consideration that arrangements be made to make liberal grants for Village Shows during the forthcoming year.

Village Shows in the past have been recognised as a means towards encouraging greater interest in agricultural matters and the improvement of cultivations.

No definite system of grants to Shows has been organised and there have of late been no village Agricultural organizations which were able to take special interest in holding these Shows. The efforts of the Society have therefore been somewhat spasmodic, and the results of its efforts have not been, in some instances, as satisfactory as could have been hoped for. With the establishment of Co-operative Credit Societies in agricultural centres, it should now be possible to arrange for an organized system of village shows.

I would recommend that a certain number of Co-operative Credit Societies—and these are organizations for mutual co-operation through which improvements of agricultural methods can be effected—be encouraged to arrange for Shows every year. During the forthcoming year, I would suggest the following ten Societies scattered throughout the Colony be asked to arrange for shows and that the Agricultural Society make a monetary grant of Rs. 75·00 each for Prizes—the Credit Society being responsible for the collection of further sums for other prizes and expenses:—

1. Magam Pattu
2. Adikari Pattu
3. Nagolle-Hulangamuwa
4. Walapane (already arranged)
5. Wellaboda Pattu (under consideration)
6.7. Galboda-Kinigoda Korales (2 shows already arranged)
8.9. Paranakuru Korale (2 shows under consideration)
10. Beligal Korale

These Shows to be open for competition to all village cultivators within the sphere of action of the Credit Societies under whose ægis the Show is held and not limited to members of the Credit Society.

In addition to the above, I would suggest that a Prize Competition be organized amongst other Credit Societies, whereby the Agricultural Society offers two prizes, viz., 1st Rs. 15/- and 2nd Rs. 10/- payable in shares of the particular Credit Society for the best and for the second best garden of food stuffs, vegetables and curry stuffs amongst the members of the Credit Society. Prize holding schemes have met with great success amongst small cultivators in other parts of the tropical section of the Empire, and the scheme at present suggested should indicate to villagers that the Agricultural Society is in earnest in its desire to see greater attention given to the cultivation of food products in the Colony.

To provide for the judging for these prizes, I would suggest that officials of the Credit Societies select what they consider the best 6 gardens, and that the final decision for first and second prizes in every case be made by the Secretary of the Society and the Agricultural Instructor for the district.

The following are the Credit Societies I would suggest for a trial of this proposed Prize Competition scheme :—

1. Minuwangoda
2. Handapangoda
3. Akmimana
4. Talpe Pattu
5. Weligam Korale
6. Pandatarippu
7. Uduppiddi
8. Hiriyala Hat Pattu
9. Makulla
10. Kumbukke Pattu

The Prize Competition scheme would absorb Rs. 250/-. making a total of Rs. 1000/-for grants to Village Communities for Shows and Prizes. Another question that requires consideration is the encouragement of Home Gardens by pupils attending village schools to which School Gardens are attached. The Director of Education is convinced that much can be done by encouraging the pupils who receive some training in School Gardens to carry their knowledge to the homes of their parents and thus establish Home Gardens. Liberal supplies of seeds have been issued for the establishment of these Gardens, and I now recommend that 25 Prizes of Rs. 10/- each be offered by the Society for competition during the year 1918.

If the Society approves of the above proposals, designed primarily to encourage a greater interest in food production at the present time, but also with the object of encouraging improvement in agricultural methods and in Co-operative Credit Societies, I will place the matter before the Finance Committee of the Board of Agriculture with a view to obtaining an increase in the Vote for Shows during the forthcoming year to Rs. 1500/-

DISCUSSION.

SIR P. ARUNACHALAM asked what the motion before the meeting was.

MR. STOCKDALE said it was that if the Society approved of the proposals, they would then be sent forward to the Finance Committee for provision in next year's estimate of Rs. 1,500 for the purpose. Continuing he said that there were 333 school gardens, but only a hundred had started home gardens and among these the twenty-five prizes would be given.

SIR P. ARUNACHALAM : May I ask whether any provision has been made for Tamil districts ?

MR. STOCKDALE replied that provision for Tamil districts was made for competition as items 6 and 7, which were in the Northern Province, namely, Pandatarippu and Uduppiddi. In the Tamil districts there was not a large number of Co-operative Credit Societies at the present time. He did not think that societies there had yet progressed sufficiently far to warrant the grant of Rs. 75 for agricultural shows.

HON. MR. TILLEKERATNE : I would point out the Co-operative Credit Societies contained members who were rich people and headmen. Was it intended to give them prizes.

The CHAIRMAN ; Would not the offer of prizes tend to induce other people to join the Societies ?

MR. STOCKDALE : The shows would not be limited to members of Co-operative Credit Societies.

COL. JAYAWARDENE : Prominent residents of the district can be asked to give some prizes.

The CHAIRMAN : They may be asked, that is a matter for the Society, whether they would give them is left to themselves.

MR. STOCKDALE said that for the Shows already arranged in Kegalle the Society had promised Rs. 75 each, but the promoters sent a paper round and obtained about five or six hundred rupees.

The CHAIRMAN : Anybody else desires to address the meeting ?

There being none the proposals were adopted.

THE CEYLON AGRICULTURAL SOCIETY.

Minutes of Proceedings of a Meeting of the Agricultural Society held on 26th November, 1917.

The 3rd Quarterly Meeting of the Society for the year 1917 was held at 12 noon on Monday, the 26th November, 1917, at the Council Chamber, Colombo.

The HON'BLE THE COLONIAL SECRETARY presided.

There were present :—The HON. SIR S. C. OBEYESEKERE, SIR P. ARUNACHALAM, the HON. MESSRS. A. S. PAGDEN, SAPAPATHY, BALASINGHAM, ABDUL CADER, TILLEKERATNE, HON. DR. H. M. FERNANDO, The Director of Agriculture, Director of Education, MUDALIYAR A. E. RAJAPAKSE, LT.-COL. T. G. JAYAWARDENE, MESSRS. R. SENIOR-WHITE, A. B. THOMSON, A. W. BEVEN, H. A. DEUTROM, H. L. DE MEL, A. BRUCE, W. A. DE SILVA, GERARD JOSEPH, H. F. MACMILLAN, R. M. FERNANDO, ALEXANDER PERERA, J. S. DE SILVA, W. MOLEGODE, N. WICKRAMARATNE and MR. KELWAY BAMBER (Acting Secretary).

Minutes of the previous meeting held at Nuwara Eliya on the 10th April were read and confirmed.

Progress Report for the quarter ending 31st October was taken as read and the Statement of Accounts for the same period was tabled.

The Report of the Land Development Committee evoked considerable discussion in which the following took part :—MR. BALASINGHAM, DR. FERNANDO, SIR OBEYESEKERE, SIR ARUNACHALAM, LT.-COL. JAYAWARDENE, MR. TILLEKERATNE, MR. SENIOR-WHITE, MR. SAPAPATHY. The Director replied to the various speakers, explaining the points raised by them, after which he formally moved the adoption of the Report. The motion was seconded by MR. ABDUL CADER and carried, and it was decided to refer the report to Government for favourable consideration.

The proposals for grants to Village Agricultural Shows, after some discussion, were adopted, setting apart Rs. 1,500 in this connection for 1918.

The Director next proposed that a Committee consisting of the Government Agent, N.P., SIR A. KANAGASABAI, HON. MR. P. RAMANATHAN, HON. MR. SAPAPATHY, C. M. CHINNIAH Mudaliyar, MANIAGAR V. M. MUTTUKUMARU, MR. V. CASSIPILLAI, himself and the Secretary, C.A.S., be appointed to consider the establishing of Experiment Stations for the Northern Province. Seconded by SIR P. ARUNACHALAM ; the resolution was carried.

With a vote of thanks to the Chair, the meeting terminated.

RUBBER.

HEVEA BARK DISEASE.

[The following address was recently given by the Government Botanist and Mycologist, MR. T. PETCH, to the Haputale Planters' Association.]

Diseases of Hevea have not hitherto been so prominent on this side of the Island as on the West. The principal disease has been Brown Root disease, especially where old cacao has been felled, and a few cases of *Fomes semitostus* have occurred. Nodules seem to have given most trouble, and it appears to be the general rule in Ceylon that these are most prevalent in the drier districts. Of the ordinary claret-coloured canker, we have had very few reports.

But this apparent immunity from disease appears to be rapidly disappearing. There is still no notable increase of the Hevea diseases which are common in the wetter districts, but, to keep the balance even, a new disease has appeared, which, up to the present, appears to be confined to those districts which depend solely, or chiefly, on the North-East Monsoon. This disease is a bark canker, different from the well-known claret-coloured canker of the western side of the Island.

The disease is usually discovered during tapping. The tree may go dry, the cortex apparently containing no latex, except very near the cambium in a layer about 2 millimetres thick. As ordinary tapping leaves a thickness of about a millimetre and a half of cortex overlying the wood, it scarcely touches this inner layer, and consequently the cooly has to tap deeper to obtain a satisfactory flow. But in such cases, one has to be cautious in deciding that the cortex is diseased, because, as has been known for many years, there is a type of tree in which all the latex is contained in a narrow zone next the cambium, so that the original bark yields very little with normal tapping.

In advanced cases, however, there is no doubt that something is wrong. The tapper, as he goes down the tree, cuts into an area in which the outer layers of the cortex are completely brown and dry, with a thin white lactiferous layer overlying the cambium. The outer layers are dead. In what seems to be the commoner case, a cortex, say 8 millimetres thick, will consist of a dead outer layer 6 millimetres thick and an inner living lactiferous layer, 2 millimetres thick. The dead outer layer forms a thick scale, or rather it should be a scale, but it does not seem to separate readily from the inner layer and drop out. In general, the dead scales appear to remain *in situ*. They are usually dry, and very hard and brittle.

In the earlier stages, the bark does not show any well-marked signs of disease. It may be slightly greyish yellow and have a watery appearance. It appears to contain more stone cells than usual. A thin brown line then appears very near the cambium, and along this line the cortex forms a layer which cuts off all the tissues lying outside it. Consequently these tissues, the outer layers of the cortex, turn brown and dry up. The brown line may appear while the outer layer of the cortex is still green.

The inner surface of the brown scale is covered by the thin white layer which is always formed when a scale is corked out, and, as usual, it is irregularly elevated and pitted. This surface of separation, in the case of this disease, usually appears wet. The underlying lactiferous layer is white, but in wet weather it turns brownish rather rapidly. On cutting into it, one often finds that it is discoloured and brownish. In some cases red-brown streaks or sheets are found in this underlying cortex and extensive plate-like or netted nodules may develop round these streaks.

This development of nodules in the inner layer of the cortex has an important bearing upon RUTGERS' contention that nodules are a consequence of canker. So long as we were acquainted only with the Ceylon claret-coloured canker, RUTGERS' statement was inexplicable, but it is quite intelligible if it refers to this (to Ceylon) new disease. One would infer either that the two diseases have been confused with one another in Java, or that the claret-coloured canker does not occur there.

The disease is usually found on the lower three feet of the stem. Whether that is only because that area is being tapped, and consequently the disease is discovered, remains to be determined. It apparently very often descends along the tap root, and may go down to a distance of two feet.

In the majority of cases, there are very few outward indications of disease. The crown of the tree does not show any signs of dying back, even when the disease is well advanced. The dried bark may crack, usually longitudinally, and, as one observer put it, it looks hard. On the root, the cracking appears to be more pronounced, long cracks running right down the tap root. The dead scales on the root are generally red-brown when scraped, and they show a blue or bluish purple coloration along the cracks. The latter colour, however, is scarcely diagnostic. I find that in many cases dead Hevea roots turn blue. For instance, in cases of *Ustulina*, where the fungus has killed a tree by attacking it at the collar and has not gone down the root, the lower part of the tap root, which has not been attacked by the fungus, will sometimes turn blue.

In one case, which at present appears to be the same disease, the outer layers of the stem bark, after drying up, split vertically and horizontally into rectangular scales. Apparently this splitting extended into the lactiferous layer, as latex exuded copiously and ran down the stem, leaving long black lines of scrap. In this case the disease extended right through the cortex to

the wood on many trees, and it occurred up to a height of six feet or more. The diseased areas were soon attacked by borers which riddled the stem to such an extent that it was broken off by the wind in some cases. The most remarkable feature of this attack was that, though the bark over a length of three feet of the stem might be completely killed all round, and the wood full of boring beetles, the crown of the tree showed no signs of diminution and the stem yielded latex freely below the diseased region. This attack occurred on trees which had been fairly severely scraped—a point to which I will return later.

The distribution of this disease, as far as it is known at present, is peculiar. It was first recorded from the Badulla and Haputale districts, and has since been found in the Dumbara district. In the latter district, it occurs within two miles of Kandy, but on the slope facing the Dumbara Valley. [It has since been found in the Galegedara district.]

It would seem possible that this disease is the same as that which has recently attracted attention in Malaya. Until last year canker of Hevea was said to be unknown in the Federated Malay States, but during the last twelve months, one or more bark diseases have made their appearance. It is not yet quite clear what they are. The first writers on the subject seem to have assumed that the chief disease there was the common Ceylon canker, and the earlier articles would appear to consist of three or four original observations extended to as many pages with details from Ceylon or Java publications. Hence the symptoms described are not those of the Malayan disease. Next it was declared that Ceylon had misled the world by talking of a claret-coloured canker when it ought to have been called brown. Now, however, the idea seems to be gaining ground that the Malayan disease is not the common Ceylon canker after all.

According to one correspondent, in the chief Malayan bark disease, the cortex becomes dirty yellowish-brown, and is waterlogged, or spongy, and latex is found only immediately next to the cambium. In old cases, the cortex rots down to the wood, but apparently only in certain patches. The attack not infrequently extends to the lateral roots and the tap root.

Another account states that the first sign observed is that the tree yields very little latex, and what does flow is only obtained by tapping very near the wood. If the tree is rested it may recover, but in other cases a dark line of cells divides the cortex into two layers ; the outer layer soon becomes dark, and though moist at first, it ultimately dries and dies off, forming a thick dark layer. Sometimes the cortex dies right down to the wood and cracks into rectangular scales. The attack is said to originate on the tapping cut and to spread downwards into the untapped cortex.

It will be seen that the above details agree fairly closely with the disease now present in this district. Here perhaps it is more usual for the tapper to cut into affected patches than for the disease to begin on the tapping cut.

The cause of this disease is not yet known. Several fungi have been obtained from the diseased bark in Ceylon, but in many cases nothing has been developed on incubating diseased bark with the precautions necessary to

avoid accidental contamination. It was recently announced that the F. M. S. disease, which is known as Brown Bast, was caused by a species of *Spongospora*, but this determination has since been withdrawn.

The treatment of the disease must follow the lines of the ordinary canker treatment. All the diseased patch must be cut out, and the shavings collected and burnt. If a separation layer has already formed, the diseased bark may be scaled off; if not, the patch should be scraped until latex appears. It should then be painted over with Brunolinum or Carbolineum, preferably pure, because these, undiluted, will penetrate to a slight depth into the underlying laticiferous layer and destroy any fungus which may have just begun to attack the latter. I have noted the attack beginning again beneath the scale. Failing Carbolineum, Brunolinum, or Jodelite, a mixture of tar and liquid fuel in equal quantities might be used.

It would seem possible that in some cases the early stages of nodule formation, especially the platelike form of nodule, are being confused with this disease. The first stage in the formation of a nodule is the coagulation of the latex in the latex tubes, with the production of a yellow colour in the walls of the tubes and the surrounding cells. If this occurs over an extensive area, the affected cortex appears greyish yellow. But this is followed by the formation of a nodule, and there is no brown continuous line which cuts off the greater part of the bark as a scale.

In some cases the attack of this disease appears to have been favoured by scraping the trees. It has now become the general fashion to scrape the stems periodically, not with the idea that it has any effect on the yield, but to make the tree look tidy—grooming is, I believe, the correct term. Now, the outer corky bark is the natural protective layer of the cortex, and if this is removed and the green layer exposed, the tree is more liable to infection until it has formed a new bark layer. "Oh," it is said, "we agree that it is wrong to cut into the green, but the cooly uses the back of a knife, and he has strict orders not to go so deep." Well, gentlemen, I have seen a good many scraped trees, and in the majority of cases it is quite evident that the cooly has gone below the green. The cooly will use the back of the knife—while he is watched—but naturally he prefers the sharp edge. And if he is given a piece of hoop iron, he will sharpen it on the nearest stone.

I have seen an extensive attack of this disease when wet weather set in soon after the scraping. As for scraping in dry weather, I have seen cases in the drier districts, where the exposed bark has died back naturally to a depth of a millimetre, and covered the stems with rectangular scales. It is certainly necessary to remove loose bark scales, and in the wetter districts it may be advisable to brush off the spongy layer on very corky-barked trees. But I think it is a matter for consideration whether the practice is not considerably overdone, and whether there is any justification for it in the drier districts. I would suggest that loose scales might be brushed off, say with a piece of coir, or a piece of coconut husk beaten out at the end, not with a solid piece of coconut husk. But wire brushes should certainly not be used.

It may be necessary to scrape trees in order to find bark diseases, the present disease in particular, but that is quite a different matter from the gratuitous scraping now in vogue.

RICE.

PADDY EXPERIMENTS IN MADRAS PRESIDENCY.

SPACING AND CULTURAL.

The spacing experiment at Samalkota was discontinued—the results were summarised in last year's report. The similar experiment at Coimbatore will be concluded in the current year when only final conclusions can be drawn. The average seed rate used at Coimbatore for producing excellent paddy crops on some 30 acres of wet land works out at 16½ lb. of seed sown on 7½ cents to transplant each acre of crop. At Anakapalle Hoogli jute and local gogu *(Hibiscus cannabinus)* were tried as a rotation with paddy. It was found that these crops exhausted the soil to the detriment of the succeeding paddy crops. At Samalkota experiments were in progress to test the value of hot weather cultivation for dry paddy. The results up to date are in favour of such cultivation. The experiment at Sirvel to compare drilled versus transplanted paddy was spoilt by the wet season which made drilling impossible.

MANURIAL.

The new series of experiments at Coimbatore to test the conclusions to which DR. HARRISON'S work on paddy soils has drawn attention will be started in the current year on land which has been carefully tested for standardization for the last five years. It has been found that by taking duplicate plots the probable error of an experiment can be reduced to 3·2 per cent. This means that any variation over 12 per cent. in the yields of two series of plots may be safely taken as representing a real difference due to factors under test, while any difference in the neighbourhood of 3 per cent. means nothing at all as it is just as likely that it is due to chance. This is the first time that the probable error of a series of experiments has been worked out in advance and our thanks are due to MR. PARNELL and DR. HARRISON for drawing attention to the importance of doing this. It is probably due to failure to realize the importance of working on these lines in the past that several series of experiments have had to be abandoned without definite results. At Coimbatore a new experiment consisted in stacking a green manure crop (daincha), covering it with earth, and allowing it to decompose under anærobic conditions for a month before applying it to the land, instead of ploughing it in green which is the usual practice. This method, which was suggested by a bulletin of the Imperial Bacteriologist, promises to give useful results. A gratifying feature of the work at the central farm is the steady increase in the average yield of paddy over the whole of the 40 acres of wet land. The figures for the last four years are as follows: 2,570 2,700, 2,870, 3,200 lb. per acre. This general increase has been brought about by steady improvements in cultivation and the continued application of phosphoric and green manures. That this improvement is a real economic success and not a mere increase in gross yield regardless of expenditure can be proved from the records of the cost of cultivation of each field which show a profit of at least Rs. 100 an acre in almost all cases and in some cases as much as Rs. 150. An experiment on manuring with superphosphate was

started at Anakapalle. The series of manurial experiments at Samalkota was continued in order to test the residual effects. A new experiment was started here to test the value of calcium cyanamide as a nitrogenous manure for paddy. The results indicate that it is of value but the experiment must be repeated for a series of years before conclusions can be drawn.

At Sirvel in spite of the bad season it was shown that superphosphate invariably increased the yield of paddy. At Palur the effect of continuous green manuring with daincha has resulted in a steady increase of yield from 2,528 lb. of grain per acre in 1913-14 to 3,920 lb. last year. The experiments on the use of artificial manures to supplant green manuring were continued. Fourteen different experiments on paddy manuring were in progress at Manganallur. It is found difficult to get comparative results on these heavy delta soils owing to the great effect of the capricious hot weather rains on the texture of these soils, an effect which persists throughout the subsequent cultivation season and greatly affects the yields. The results of the experiments are discussed at length by the Deputy Director in the Report on the Agricultural Station and cannot easily be summarized here. Speaking generally soluble phosphatic manures have given markedly increased yields, especially when used in combination with either green manuring or ammonia salts. Experiments of special interest were started at the suggestion of DR. HARRISON to test whether ammonium sulphate or cyanamide can replace green manuring. The results were inconclusive as these concentrated nitrogenous manures caused the paddy to grow so tall that it had to be cut back to prevent it becoming laid before it was in ear. The experiments will be tried again with smaller doses of these manures.

VARIETIES.

The work of evolving and preliminary testing of new strains of better paddy is being done by the Government Economic Botanist. These new strains will be further tested on a larger scale on our farms before being given out. A start has been made with this testing this year; some of the old selected strains are still being tried on the several farms; and comparisons are also made between the yields of unselected seed of various local and foreign varieties. Of two new strains tested on the Central Farm, Coimbatore, one, No. 24, was a success, yielding 3,600 lb. per acre and giving a grain yielding a high percentage of husked rice. The other selection proved a failure as it ripened very early and so suffered from the depredations of birds. Six of the old strains were again tested at Coimbatore and the best of these, Sadai Samba 20, gave the magnificent yield of 4,800 lb. per acre of paddy on a 10 cent plot. A comparison at Anakapalle between four local varieties and Godavari Konamani was in favour of the latter, the yield being just under 3,000 lb. of grain per acre. Six local varieties were compared at Samalkota but the results were vitiated by overmanuring which caused the crops to lodge badly. A start was made with testing two single plant selections from the local konamani paddy. At Palur twelve short-duration foreign varieties from the Central Provinces have been tested since 1910, with a view to finding one which would be suitable for lands with a precarious water-supply. It has been found that these imported varieties tend to become of longer and longer duration, and many now take a month longer than the local varieties to come to maturity. This experiment will therefore be discontinued. Thirteen second crop varieties have also been under comparative observation since 1909. Sufficient having been learnt about their duration and yield the experiment will be discontinued and the most suitable varieties grown as farm crops to supply seed for distribution to ryots.—REPT. ON THE OPERATIONS OF THE DEPT. OF AGRIC., MADRAS PRESIDENCY FOR THE OFFICIAL YEAR 1916-17.

THE CULTIVATION OF DRILLED PADDY IN SOUTH BOMBAY PRESIDENCY.

The above is the title of Bulletin No. 82 of 1916, Department of Agriculture, Bombay.

The country referred to is known geologically as the Transition Tract where the Deccan Trap Formation overlies or meets soils formed from granite and gneiss which characterise the whole of Southern India and Ceylon.

RAINFALL.

The rainfall of this area varies from 30-40 inches in the more northerly parts to very nearly 70-80 inches in the Southern parts. Where the rainfall exceeds 80-100 inches rice is transplanted and grown in very much the same way as is common in Southern India. The bulk of the rain falls during the South-West Monsoon.

SOILS.

The country is hilly with a good supply of water. The common feature of the rice soils is the extreme fineness of the particles causing them to set very hard when dry. They may broadly be distinguished according to situation e.g. the low-lying moist soils and the hillside fields with a gravelly soil.

Rice is grown irrigated or as a dry crop—the difference is really only one of degree. Fields may be terraced along valleys and hillsides. They may be watered by streams with some sort of a head-work of embankment unless they are controlled by a storage tank.

THE COLD WEATHER PULSE CROP.

The low-lying fields give heavy crops and also allow of a cold weather crop of pulses being taken without irrigation. Peas and lentils are the commonest crops; they may be sown with two rows of mustard or linseed alternating with six or eight rows of the main crop. *Dolichos lablab* as a green fodder, a green vegetable or a dry grain is very common. Melons are grown on a small scale.

The pulses are sown in December-January after paddy harvest which is generally during November-December. The seed is sown behind the plough and covered over with a sort of plank harrow which is worked two or three times so as to crush any clods that may have been raised. The pulses are harvested at the end of March. The preparation of the soil for paddy then begins.

THE CULTIVATION OF THE PADDY CROP.

Wherever soil conditions do not permit of the growth of a cold weather crop of pulses preparation of the land for next year's crop begins immediately after paddy harvest. This consists of a ploughing in November-December; a cross-ploughing in January; clod-crushing generally from December to end of March (the use of a clod-crusher about 6 times and also a hand implement about 3 times); harrowing 4 times in March-April; manuring in May and sowing in the same month when the rains begin. After covering the seed and levelling the soil is packed. During May-July the crop receives about six interculturings. Under wet cultivation a blade harrow is used which very efficiently eradicates weeds, these being picked out subsequently as they appear floating on the water. The subsequent weeding varies greatly needing the employment of about 16 women to an acre in July-August and say once again during August-October. In November the crop is harvested.

IMPLEMENTS.

The bulletin contains 23 figures drawn to scale with details of the various indigenous implements used. All of them with the exception of the plough are remarkably well adapted for the uses to which they are put. "The extraordinary variety of implements in use" is commented upon as "the most striking feature of the cultivation of drilled paddy." "They are designed, (1) to break the soil after harvest, (2) to level the surface and at the same time to break clods, (3) to reduce the soil to a very fine seed bed, (4) to sow the seed, (5) intercultivate and to remove weeds, (6) to puddle the soil and at the same time to remove weeds."

These implements are worthy of introduction in our Dry Zone where the drilling of paddy may with advantage be experimented with. The seed-drill consists essentially of a head piece of some heavy hard-grained wood which gives support to all other parts. Six coulters are set obliquely in the head piece. They are wooden prongs or tines with a round hole in each and shod each with an iron share. The distance between each coulter is about a foot apart. In each of the holes a vertical bamboo tube is inserted. These tubes as they rise incline towards each other and support the seed-bowl. The wooden bowl has as many perforations as there are tubes. The different parts of the seed-drill are held together by ropes. The seed is fed into the bowl and regulated by the sower. Thirty-six to seventy-two pounds of seed is sown, the smaller seed-rate on rich soils.

The interculturing implements consist essentially of a horizontal iron blade attached at an angle to the head-piece. This blade is of varying length and shape according to the width of the rows. They are worked between the rows, straddling the crop and very effectively eradicate weeds, loosen the soil and earth up the plants.

VARIETIES.

The cultivators know a great deal about varieties. A very large number are grown. The finer varieties do not pay so well as the growing of "*Doddagya*, a coarse variety grown on hillsides which takes 4½ to 5 months to mature and yields 900-1200 lb. per acre." Small *mungad* and *antersali* yield 1200-1400 lb. per acre in fields that are intermediate in character. *Mungad* has white stems and *antersali* red stems, a difference whose importance is very great in the eradication of a wild awned rice *(gouad)* which occurs as a very bad weed. Big *mungad* and big *antersali* sown in low-lying moist fields yield about 1500 lb. per acre.

THE GONAG WEED.

The wild awned rice which is carefully kept under control and at considerable expense is considered to be a cross between wild and cultivated rice. It is indistinguishable until it forms ears when the grain is found to mature unevenly and to fall down on maturing. Harvesting of this grain is therefore impracticable; otherwise it is not of a bad quality. "Every variety of paddy grown seems to be accompanied by its own special variety of *gonag*." The cultivators therefore rotate red and white stemmed paddies so as to distinguish *gonag* seedlings which can then be weeded out. They also often rotate drilled with transplanted paddy, so as to destroy the *gonag* seedlings during the puddling process. Sugarcane for the same reason is also often rotated with paddy so as to admit of cleaning the fields of *gonag*.

H. L. VAN B.

FRUIT.

CULTIVATION OF THE MANGO.

BY M. SUBBAIYA, B.A.

Mango is called the King of fruits, the Apple of the Tropics and the fruit of Paradise. It well describes these appellations. There is no other fruit in creation that can equal it in shape, colour, fragrance, savour and variety. There are more than five hundred varieties grown in India, and the peculiarity is that each one possesses some qualities not found in others. Even the preparations of unripe fruits are superb, such as chutneys and pickles. Though it is said by WOODROW and others that the home of the fruit is Florida, yet by its constant mention in our Puranas and the perfect condition to which it is grown in almost all parts of India, we can safely conclude that it is a native of India. During the season no other fruit comes to the market and the mango reigns supreme.

The fruit finds a place on the table of the Rajas and is eaten by the beggars on the road side and no other fruit is so accessible to the rich and the poor alike. Yet strange to say there is no other fruit-tree that is so very neglected as the mango. It is planted generally in soils unsuitable for any other crop and made to get its supply of food from the air and mother earth, and water from the high heavens. With all this neglect, being a divine fruit, it showers its blessings upon those that fail to tend it. If it cannot assimilate enough food from the soil in one year to yield a good crop it takes rest that year and assimilating more bears abundantly the next year. The tree is very hardy and resists many insect and fungus diseases. It is a pity we do not bring up the tree with the care commensurate with the benefits we derive from it.

The worst soil is selected, a few handfuls of manure are thrown in while planting, and the plants are watered barely for a year or two after planting and then they are left to take care of themselves. The result is that the mango garden which should, under proper cultivation, give a profitable crop in four years does not begin to bear fruits even after six years. Grass, weeds and shrubby plants are allowed to grow wild in the garden which takes away from the soil the little fertility it possesses and also the moisture got from the rains. It is never ploughed or in any way opened out to receive all the rain water falling on it and retain it in the subsoil, so that the tree may draw on its reserve during drought. Under these circumstances the garden becomes impenetrable through over-growth and a breeding place for insect pests and other diseases. Parasites are allowed to grow on the trees which suck away much of the nourishment they possess.

People complain that a mango garden is not a paying concern, and how can it be if they keep it in this gross state of neglect?

Nitrogen, phosphoric acid, potash and lime and other materials which the tree absorbs from the soil, which the fruits accumulate in their luscious and juicy parts are removed when the fruits are plucked for the market. Unless these substances are returned to the soil in the form of manure, and the soil kept clean and opened out to receive air and moisture, for converting

the crude materials it contains into soluble substances, so that the roots hairs may absorb them easily, it is very unwise and greedy on the part of man to expect any return from the trees. Treat it well, give it at least one-tenth of the attention you bestow upon other fruits, keep the garden free from weeds and shrubby growth, get the land ploughed up deep in the beginning of the rains and also in November or December, manure the trees once in two years or grow some green crops and plough it in, prune away all dead wood and remove all the parasites from the trees, and you will find that your labour will be repaid hundred-fold, and the garden so kept will be a legacy to your children. If properly taken care of there is no other crop that is so very profitable as the mango. A fruit which could be sold cheap and which the poorest could afford to purchase is the fruit that will pay well and such a fruit is the mango.

I do not think the trees need artificial irrigation when they are well established unless they are planted in an unretentive soil and with low water level. In such a case they should be irrigated thoroughly twice a month from December onwards till the fruits get ripe. If the land is kept open by constant ploughing rain water is quite ample to keep the trees in good condition. But manuring once in three years is quite necessary to renovate the trees. Trees that are planted near tanks, and on soils with high water level and those that were irrigated, are found to be more healthy than those that are planted in the plains away from any water reservoir ; and I found that these trees were comparatively free from the honey disease that played havoc with the whole crop in Bangalore and the suburbs year before last.

The cause of this honey disease is not explained satisfactorily by any body. But what happened was, the rain we got in the N.E. monsoon was very much below the average and continued only till November, and the cold weather was not practically felt. Summer and dry season began very early and *Raspuri* variety of mango trees began to blossom about the beginning of February, so much so that the trees were laden with blossom and so profusely in many instances that the foliage was entirely hidden by the flowers. Every body thought that if at least one per cent. of the flowers could set fruit, the local markets would be glutted and the price would be so low that they would sell at Re. 1 per 100. The weather was very dry. But about the 20th of February, for about three or four days, clouds appeared in the skies and the weather became very sultry and warm. Previous to this, although there were slight clouds, there was breeze also along with it, and the flowers did not suffer. But when the breeze stopped and the weather became sultry and suffocative and continued so for three or four days, the leaves were coated with a varnish like viscid sweet covering like honey dew and afterwards the flower stalks turned black. Gradually the flowers began to drop off and it was surprising to see trees so fully laden with flowers quite bare after a week. Those varieties that had set fruits partially before the advent of this severe weather, and those whose blossoms had not opened during that period escaped from the plague ; as also those planted near tanks, and were well cultivated, and irrigated partially resisted the disease. It is these trees that yielded a moderate crop of fruits. Even after this, dry hot weather continued till the 8th of March and consequently a large percentage of the fruits that set, dropped. We had slight showers of rain on the 9th, 10th, and the 11th of this month and the half-ripen fruits stopped falling off.

After the short cloudy weather and the commencement of this honey dew, the presence of the insects, called the mango-hopper, was observed and in a week's time they were to be found in myriads. The flying of these insects from leaf to leaf resembles the sound of a shower of rain falling on the leaves and any body going near the trees would feel their presence as they strike their face, enter their mouth and nostrils and dash against every part of their body and make them run away from the trees. Also between the 15th and 23rd of the month there was heavy dew which lasted till 9 a.m. in the mornings for two or three days. Fruit-sellers in Bangalore say that after a heavy dew, the honey disease appears. This happened also when the blooms had opened and I believe the dew must have interfered with the discharge of the pollen freely. This, added to the cloudy weather that followed, and the dryness of the soil, combined with the atmospheric drought, and abnormally high temperature caused the flowers to shrivel up. And this helped the advent of the disease.

Flower stalks of large trees that were exposed to the dew were the chief sufferers from the effect of the dew, but those that had been sheltered beneath the exposed branches and those on small trees practically escaped from the disease and bore fruit. All the trees will not be inflorescent at the same time : some varieties bloom and open early, some late, even on the same tree, some flowers would be unopen, some half open and some fully open. It is those that are fully open that suffer from the effects of the weather.

Whether the failure of the crop is caused by the presence of the mango hopper or the prevalence of dry sultry weather at the time when the flowers are about to be pollanised, or whether it was caused by the fall of heavy dew for three days or whether such weather assists the increase of the mango hopper, I am unable to say. It has been observed in the previous year that if there is a sharp shower of rain immediately after the existence of the above conditions the tree is freed from the mango hoppers provided the flowers are in bud or are pollanised by that time, but on the other hand if the flowers are open at that time pollanization does not take place as the pollen grains would be washed off and the fruits consequently do not set. Every mango gardener or contractor dreads the cloudy weather and heavy dew, his profit and loss depending upon this weather. WOODROW says that if the hot cloudy weather occurs while the trees are in blossom, the flowers mostly wither and fall off with one fertilization and then each flower has only one developed stamen ; and the remedy suggested is to spray the trees with a solution of crude kerosene emulsion (one pound of emulsion to ten gallons of water) before the flowers open. This should be done every time the new shoots appear so as to kill the nymphs.

It will be alright to do so provided the trees are small and the garden possesses only a few trees. But with large trees it may not be practicable. The best course which a wise gardener should adopt is to keep the garden clean, get it ploughed deep twice or thrice a year, and as stated above if the trees are planted in high plains with low water level and away from any water reservoirs, to irrigate copiously the plants twice or thrice a month till the fruit ripen, and then the trees would be able to resist all these diseases. It is always better to pay attention to intensive cultivation to fruit trees than having recourse to insecticides. The first and foremost duty is to make the plants strong, so strong as to resist any ravage of insects or pests.

Any body visiting a large mango garden during inflorescence will have observed that trees in the edge of the garden and especially branches that are well exposed to the sun and air are the ones that are most in blossoms ; while trees that are in the interior of the garden which are usually planted closely seldom have any flowers excepting at the end of the branches that are well exposed. When the weather becomes cloudy during the time the flowers are open and heat increases, one can also observe that the plants that suffer most and are liable to the mango-honey disease, are those that are planted in the middle of the garden. Those that are planted in the edge of the garden do not suffer so much, as they would get good breeze even though the weather is very close and suffocative. Hence the necessity of planting trees at certain distances apart, so that when they grow up to their full size they may be fully exposed to the action of the sun and air. There is also another advantage by so doing ; insect pests that damage the leaves and fruit cannot get a hiding place, and by exposure to the sun many of them would be killed. Wide planting will also facilitate ploughing and other cultural operations.

PLANTING.

Plants grafted from fruit bearing trees should always be got from reliable nursery-men. It has been my experience that trees purchased from Salem and planted fifteen years ago have not borne fruit till now, while plants grafted in Bangalore have begun to bear fruits three years after planting. There is no other plausible explanation of this, but that the former was grafted from young plants while the latter from fruit bearing trees. The usual distance of planting should be at least thirty feet apart for reasons already given. Pits three feet deep should be dug and the top soil mixed with charcoal, manure that is well rotten and broken pieces of bone if available. It is better to get the pits dug the previous year and exposed to the action of the sun and air. By so doing any injurious pestilential insects and microbes in the soil and roots of injurious grasses would die, and the soil gets well aerated.

If the soil is sandy, pits may be made broader and red earth and loam mixed along with the manure. In clayey soils the pits should be made deeper to facilitate drainage, a few cracks are put in the bottom of the pit, the soil thrown out should be mixed with a basketful of manure, a few handfuls of bone meal, a potful of lime dust and a little charcoal. One or two basketfuls of sand may be mixed with the soil.

Pits should be filled up while rain is falling, a week or two before planting as instructed above. Before planting, the mixture in the pit should be turned over once or twice so that when planting the whole of the contents of the pits may settle down well.

When the weather is cloudy and there is likelihood of its raining in a day or two, take the plants with the pots near the pits, make a small hole in the middle of the pit so as to hold the ball of earth (*hundi*) contained in the pot, break open the pot gently loosen the bottom of the hundi and place it gently in the hole, cover the hole with some extra soil and press gently around the tree with your right foot. Take care that the grafted portion is not buried in, but should stand at least nine inches above the soil. Tie a stick to the plant and water the pit copiously. If on the second day the soil has sunk put in some more soil to fill up the space.

Plants should be watered if it does not rain after planting. If the sun is severe a covering should be provided for the plants to keep out the midday sun. An intercrop needing irrigation may be raised till the trees grow to about ten or twelve feet and begin to yield, and the cultivation given to the crop would be quite ample for the trees also. When the trees begin to bear they require the whole soil for themselves.

It is very essential that trees newly planted should receive no check in their growth. It is on that account pits are manured before planting. During the growing period till the wood is well developed and the trees begin to bear, manure should be supplied to the plants either in a solid or liquid form in the beginning and end of the rainy season, and if in spite of this the plants should halt in their growth some stimulant such as powdered oil-cake may be given in a liquid form once a fortnight till the plants resume their natural course.

There is difference of opinion as to manuring the trees in their adult stage, but I have found that ten to twenty baskets of farm-yard manure or five to ten baskets of night soil mixed with a basket or two of wood ashes given to the trees just before the rains cease in October, that is, in *Swathi* would benefit the trees considerably. The usual method is to spread the manure five feet away from the trunk of the tree to the extent to which the branches spread, and two or three feet beyond also, and plough in the manure with an iron plough deep into the soil. Another method is to dig a trench four or five feet broad and two feet deep around the tree where branches terminate and to apply the manure and close the pits with the soil. Ploughing and digging are also advantageous as they will also prune the small fibrous roots and then stimulate fresh growth in the tree.

As to irrigation, opinion is also divided as to whether the trees should be irrigated when they have grown to a large size, but in Bangalore at any rate no body irrigates mango gardens. Yet, trees planted, in high water level, as I have already pointed out, are in better condition than those planted in high levels, and those that are planted in a retentive soil thrive better than those planted in sandy soil; hence we may conclude that irrigation during dry season would be very advantageous to the trees. Copious irrigation twice a month from the time the flowers appear till the time of the ripening of the fruits is also very beneficial.

This may answer well for small gardens, but as it is not possible to irrigate large plantations, deep ploughing before the rains set in, so that the rain water falling on the plantation may soak into the soil and conserve in the subsoil for future use, and surface ploughing again after the rains are over, so that the land may not form a hard crust on the surface, and thus prevent the moisture coming to the surface by capillary action and get evaporated, should be resorted to.

Propagation is made by grafting and budding, but the latter method is not found successful in Bangalore. As there are many nursery-men that have made this work a profession it is not worth while for private men to try grafting, because large sized plants can be bought for about eight to ten annas a plant of the *Raspuri* variety. Some people recommend small plants for planting, but I have planted such plants about one foot high in my gardens, and though it is two years since they were planted have not grown

at all ; while plants eight feet high grafted in my garden and planted out two years ago have grown up to twelve feet high and are bearing fruit ; but the stock must be as thick as the scion or else large plants will be a failure.

VARIETIES.

There are many varieties of which glowing descriptions are given in the catalogue of nurserymen in Calcutta, Poona, Saharanpur, Salem, etc.

It is but natural that people of a certain country should praise their own produce however inferior, comparatively speaking, they may be to others. I got from these places many of the varieties mentioned above but found that, with the exception of a few, almost all were far inferior to the famous Bangalore varieties, viz.: *Raspuri, Badami* and *Malgova. Raspuri* is called *Paire*, and *Badami* "*alphonso*" in other parts of India. The very fact that *Raspuri, Badami* and *Malgova* are exported by wagon loads to Madras, Bombay and other places prove the superiority of their quality. The following varieties are grown in Bangalore :—*Raspuri, Rajpuri, Badami, Malgova, Sundershaw, Neelam and Amini.*

DISEASES.

The mango tree is a very hardy one and so it is able to withstand any disease provided good cultivation is afforded to it.

The diseases that generally attack the tree and the fruit are the following :—

Mango Fruit Fly.—Fruit flies do harm generally when the fruits are ripe. Eggs are laid on fruits, being thrust just under the skin by the ovipositor of the female fly. The white grubs on hatching burrow into the fruit, tunnelling in it and completely spoiling it. When full grown they emerge and pupate in the soil. The total life-cycle occupies about fifteen days. When badly attacked, fruits are opened, maggots jump about, the pupa is seed like and white. The adult has got orange banded wings. This is a serious pest of mangos. The attacked fruit changes its colour and there will be unhealthy patches on the fruit.

Control.—Prompt destruction of all attacked fruits by burning or burying them deeply under ground. It is not of the slightest use to throw the fruit down on the ground as maggots will emerge in due course as flies, which will attack other fruits. In some countries a net is tied all round the tree, to prevent the flies coming to the tree and laying eggs in the fruits.

The Mango Stem Boring Grub.—This is found everywhere, and seems to emerge at the beginning of rains in May and October. Eggs are laid in or under the bark and the grubs tunnel into the stem. They are big in size and have strong jaws. They pupate in the stem.

Control.—We can remove the grub by a hooked wire or inject carbon bisulphide into the hole made by the grub where accessible, or light traps can be put in the garden as the beetles are attracted by the light.

The Mango Weevil.—This pest is found where mangos are grown in Southern India, usually in June and July.

Life history is not fully worked out. This is a small creature black in colour, one-third inch long. Eggs are probably laid in the young fruit into which the newly hatched grub bores, taking up its position inside the embryo mango stone, whose interior it devours. When full fed, the grub

pupates inside the stone and the weevil bores its way out. The weevil survives as adult until the next mango season. This is not a serious pest as a rule. Remedies are not yet known.

The Mango Hopper.—This pest is found everywhere. The insect is very active, the flying of these insects from leaf to leaf resembles the sound of a shower of rain falling on leaves. Small eggs are laid in shoots of the food plant. The young are similar to the adult but wingless and the legs are comparatively longer. The bugs, both nymphs and adults feed on the sap of shoots and flower stalks, excreting a sticky substance (Honey dew) which when bugs are numerous, is produced in very large quantities and a characteristic black fungus soon grows in the honey dew. Flowers fail to set fruit.

Remedies.—Spraying of mango trees with crude oil emulsion (one pound of emulsion to ten gallons of water), before the flowers open. This should be done at every time when new shoots appear so as to kill nymphs. After the flowers are opened the bugs may sometimes be driven from the trees by kindling smoky fires below them.—MYSORE ECONOMIC JOURNAL, October 1917.

THE NEGLECTED POMEGRANATE.

Of all fruits at present grown, merely as a fruit pleasant to the taste, the pomegranate is probably the one of which we have the earliest records in history. It is mentioned with honour in the earliest writings extant of the nations who are the parents of modern civilization. HOMER mentions it in the Odyssey as grown in the gardens of Phœnicia, and the references to it in the Bible, from the Mosaic books onward, are frequent, as will be easily remembered.

The pomegranate is probably a native of the western parts of Persia. Thence it was dispersed eastward and westward to China on the east, and along the borders of the Mediterranean to the west, very early in historic times. Wherever it was introduced it was held in high esteem as a fruit. The conquerors of the Western Hemisphere, among other fruits, such as the orange and its relatives, did not fail to introduce the pomegranate, so long cultivated in Southern Spain. Since then the cultivation of the pomegranate has spread through all the tropical and semi-tropical regions of the new world. And yet to-day it is one of the most neglected fruits in these parts of the world; the reason being probably want of care in cultivation, and no attention to selection, which has caused deterioration of the fruit.

In the United States, however, there has been of late more interest in this neglected fruit. There are still descendants of the old pomegranate trees planted by the first Spanish settlers in California. These are still of a fair quality, but distinctly of a mongrel seedling type. As a possible fruit for export to northern markets the pomegranate has been the subject of experiments at the College of Agriculture Experiment Station, Berkeley, California.

From BULLETIN No. 276, January 1, 1917, the following particulars as to variety and culture are taken :—

There are two general types of pomegranate grown in California at present, the white flowered type and the pink or red-flowered type. The white-flowered type is considered undesirable for cultivation as wanting in attractiveness, flavour, and keeping quality. As to the red-coloured type, the different varieties vary in every direction, but among them there seem to have been evolved varieties of great merit. There are only five which at present are found to be of value in the fruit market. Of these the one which is most in favour in California, and which has taken a place in northern market, is the one which is designated "Wonderful." Apparently this is a sport from Florida cutting brought to California in 1896. Both from description and from illustration it must be an attractive fruit.

As was said above, the pomegranate is a very neglected fruit in these islands, because, like the California variety before selection was brought to bear on it, the pomegranate in the West Indies is only a mongrel seedling. The importation of fine varieties, the selection of promising native varieties, and a little attention paid to its cultivation might bring to public favour in these islands this most ancient fruit.

The climate suits the pomegranate, for although it is grown in the East in almost desert regions, being well adapted to withstand drought, yet it will grow and fruit well under conditions of heavy rainfall, thus making it adaptable to dry islands such as Antigua, or to wet ones such as Dominica. The pomegranate, therefore, in its improved varieties may be well worth experimenting with by our West Indian horticulturists.

The propagation of the pomegranate in the West Indies, as far as is known by the writer of this article, is only by seedlings. These can never be depended upon to reproduce exactly the characteristics of the parent plant : hence the failure to keep up a good type of plant. It may however be easily grown from cuttings. Hardwood cuttings 10 to 12 inches long, and from $\frac{1}{4}$ to $\frac{1}{2}$ inch diameter, cut from the shoots or suckers of a pomegranate tree, will grow readily when planted in the open ground. In this way a desirable variety can be maintained and multiplied. In this way also the pomegranate may be employed to form a most efficient and ornamental hedge. Cuttings set out in double row, say, 8 feet by 4 feet and pruned strongly in early stages of growth, will soon form by growth of suckers an impenetrable hedge, and one which in the blossoming season is a thing of beauty.

The pomegranate is no more exacting in its soil requirements than it is in the moisture that it needs. It does best, however, on deep soils, of a fairly heavy nature.

It is not probable that any trade to northern markets in pomegranates will soon be accessible to West Indian growers, although the tough rind of the pomegranate endues it with remarkable keeping powers ; yet as a most refreshing and piquant fruit, when of good variety and in good condition, it is to be recommended to more attention on the part of our local horticulturists for local markets.—AGRICULTURAL NEWS, Barbados, September 22, 1917.

FOOD STUFFS.

THE SWEET POTATO AND ITS CULTIVATION.

(Being a Lecture delivered by Mr. H. E. Wright, Fairfield, to the Jamaica Agricultural Society.)

Of late years the sweet potato has become one of the most generally cultivated of the food plants of Jamaica, and indeed of the West India Islands.

It is not known by botanists where this plant was first discovered but it is thought to be a native of both the Old and New World.

In NICHOLLS' TROPICAL AGRICULTURE we are told that it formerly grew in the woods of the Malayan Archipelago, and the name *batatas* is the one by which it is known in the Far East. It is mentioned in history as far back as the year 1510 by an author named PIGAFELLA, who visited Brazil and found the potato as an article of food among the Indians. After that it was introduced into Spain and other European countries, and in England it was at first sold as a great delicacy. As an article of food the sweet potato is said to contain more nutritious material than the common or "Irish" potato, but perhaps on account of the amount of sugar it contains it is not as popular with the natives of temperate climes as the common potato. In this country potatos are of all sizes, varying from a few ounces in weight to as much as twelve or fifteen pounds weight; but it is stated that in the island of Java, they have attained the enormous weight of fifty pounds a piece.

In speaking of suitable soil for sweet potatos, it is generally conceded that the best soil is a light friable one, as free as possible from roots of trees and stones. The plant also does best in a warm climate, although it will thrive in the mountains of the tropics up to high elevations.

There are a great many varieties of sweet potatos no doubt as a result of cross fertilization, and those various kinds are known, many of them, by different names in different districts. In my early boyhood days the chief potato that I knew was one called "Prince," so named because it was introduced into the parish by a Minister of that name. Then later on the most renowned was one called "Joseph" a potato with large leaves and stems.

At the present time we have Sarey, Lewis Daly, Tom Tom, Costa Rica, Yellow Coby, Black-slip, Prison-farm, Pigtail, Mingo, etc. Of all these the Sarey potato ranks first in point of popularity. It has become popular because of the fact that it thrives almost anywhere, and it matures quicker than any other, and is very easily cooked. Its disadvantages are that after one season unless great care is exercised it soon dies off; and the owner of a field of Sarey unless he is quick in getting plants while the field is in full vigour, will soon find himself without plants. Next in popularity to Sarey come Lewis Daly, which in my opinion is a cross between the Joseph and

some varieties of a harder nature. This is another variety that will thrive on any kind of land—rich or poor, sometimes the richer the better, provided the ground is well dug up. The plants are not easily killed by drought, and while the tubers of the Sarey cannot keep long in the ground when they are ripe, those of the Lewis Daly can remain much longer, getting more delicious as they become more mature.

The variety known as Tom-Tom in this locality is losing its popularity, perhaps because it cannot move along as quickly as those I have already named, but it is a better eating potato than any of the others already mentioned; and when roasted or baked in the stove is very appetising; but, as already stated, you must give it from seven to eight months.

The next variety to which I now wish to draw your attention is the one called Yellow Coby, a specimen patch of which can now be seen growing in the school garden here. This is a variety that requires rich soil, but not exactly the soil of "new" lands; what it wants is a portion of the garden which has been well forked, and to which a liberal supply of farm-yard manure has been added. MR. J. H. LEWISON of Knockpatrick, in this parish, is my authority for saying that at present it is the kind which lends itself best to good tillage and heavy manuring; but if you are in a hurry to get potatos don't plant Yellow Coby.

Leaving varieties, let us briefly consider how to prevent the good kinds which we have from "running down." At present we go to an old field when we want plants for a new field, and then next season we take plants from the last field, repeating the process until we begin to discover that this or that variety is not doing as well as it used to do, and then we rush off to the next district for the latest good bearer.

Now the above system is not the correct one to follow. Those who have studied the matter carefully tell us that a better way would be to select some good sized tubers, and in the spring time plant them at a place where they will be sure to grow and produce a good quantity of "slips." Then when the planting season comes in the fall of the year, we will be able to cut from the above planting, slips that are vigorous; and we will find that we will have strengthened our plants with better chances of a good crop when the time of reaping comes.

Perhaps one of these days, the Department of Agriculture, or better still some private individual will succeed by cross fertilization to evolve new and more prolific varieties than those which are being grown at present.

There is another important principle which must not be overlooked if we wish to keep up the various kinds which we have voted to be good ones, and that is we must be careful in planting not to mix the different kinds; but to plant each kind in its own separate patch. There is no great difficulty connected with doing this, because in setting about gathering plants for a new field all you have to do is to make separate bundles according to the number of varieties you intend to plant, and plant each bundle in its own proper place. This will prevent the plants of stronger growth from killing out or weakening those of a more delicate nature; and it will also prevent us from interfering with those that take a longer time, when we go to dig in the quicker ones.

Respecting how sweet potatos should be planted, I ought perhaps to say very little, seeing that nearly all the gentlemen present are growers of sweet potatos, and from their experience must know the best way to plant; and it seems to me that a good deal of success of planting most of these articles depends upon the kind of soil with which the plant has to contend. I have seen people just wrap up an indifferent bundle of slips and fling it into an indifferently dug hole, and hurriedly cover up the whole bundle, getting fair and good results when the reaping time came; yet if the majority of us were to try such a method we could not hope for a good crop.

Sweet potatos can be planted to advantage either in hills, holes or ridges. The last way is not practised except when planting is done on a small scale. The advantage of planting in hills is that the crop is very easily gathered in; but on the other hand the prædial thief finds it quite easy, even in the dark, to plunder and take away his neighbour's potatos. Planting in holes that are properly dug allows the field to be more quickly covered over with the slips, and thus to check the growth of weeds, the getting out of which is one of the greatest items of labour in cultivating a field of sweet potatos. If larger areas of potatos are to be planted out, and if the ground will allow it, the use of the plough will very much lessen the work and reduce the cost of planting.

As regards time the best period in most localities is between September and January, but there should always be some amount of planting in the spring time, so as to insure a good supply of plants for the fall of the year.

These are but a few brief hints by way of opening up the subject for the discussion which I am sure you are prepared now to begin; if anything which I have mentioned will help in any way towards the improvement of sweet potato cultivation, especially during this period of the war, then I shall conclude that my short paper has not been written in vain.—JAMAICA AGRICULTURAL SOCIETY JOURNAL, August 1917.

ECONOMIC VALUE OF PEANUTS.

EXCELLENT FEED FOR STOCK.

Hawaii now imports a very large percentage of the fat consumed by her population. This fat is chiefly contained in butter, lard and lard substitutes, meats, milk, eggs, fish, soya beans and olive oil.

If required to produce substitutes which will supply the fat now imported in the above-mentioned commodities, we shall have to rely to a very large extent upon the humble peanuts. The seeds of this easily-grown and quick-maturing plant contain a very palatable fat which, as peanut oil and peanut butter, may be substituted for olive oil, lard and butter with more or less success. If no other fat was available we could, no doubt, worry along quite comfortably on peanut fat alone.

The peanut belongs to the bean family. Like the common garden bean it has developed two general types of vines, the "bunch" or "bush," and the "running" or "creeping." It produces pods in much the same manner as the garden bean, but before these develop to any size the flower-stalks elongate and, growing downward, thrust the young pods into the ground, where they develop into so-called nuts. If the plant does not succeed in burying its young pods, it matures no nuts.

In the Southern States it has been found that profitable crops of peanuts can be raised on soils too poor for any other crop, but the big crops of peanuts are raised on soils of high fertility.

Peanuts delight in a light, well-drained sandy loam containing a high percentage of lime. They will grow well in an acid soil, and produce few nuts when grown in a stiff, hard soil. They may be planted and cultivated much the same as garden beans. The bush varieties should be planted 4 to 8 inches apart in rows 2 to 3 feet apart, and the running varieties in rows 3 to 4 feet apart. The smaller seeded varieties may well be planted in the pods, but the larger varieties should be shelled. There is a special peanut planter on the market and doubtless the various types of corn and bean planters can be used to plant the shelled peanuts. One to two bushels of nuts are required to plant an acre.

Peanuts require from 150 to 170 days in which to mature a crop from seed. The ripening of the plants is indicated by a yellowing of the foliage. If the plants are growing in a loose, friable soil, most of the nuts can be obtained by simply pulling up the plants, but it is usually advisable to employ a fork and turn each plant out, as you would a hill of potatos. A horse-drawn digger, similar to a potato digger, may be used where there is any considerable area to be harvested. The uprooted vines should be stacked in small shooks or piles, and allowed to cure, after which the dry nuts may be picked off by hand.

According to the Bureau of Crop Estimates of the United States Department of Agriculture, the average yield per acre of peanuts in the Southern States for the past five years has been as follows :—

	Bushels.		Bushels.
North Carolina ...	42	Alabama ...	37
South Carolina ...	45	Louisiana ...	32
Georgia ...	40	Mississippi ...	34
Florida ...	36	Texas ...	33
Tennessee ..	48	Oklahoma ...	38

The average yield for the entire peanut-growing area in the United States for the same period has been 38·6 bushels per acre.

The highest yield of peanuts on record, so far as we have been able to determine, was obtained in Alabama where one DR. J. F. YARBOROUGH is said to have harvested 214½ bushels (5,148 lb.) of nuts from one acre. He employed the Spanish variety and planted the nuts four inches apart in rows seventeen inches apart. His soil was deep, loose sand, and he gave it a very heavy dressing of ground limestone, acid phosphate and kainit.

Peanut butter is prepared by simply grinding up the roasted kernels into a fine pulp. If too stiff, the pulp may be rendered more plastic by the addition of peanut oil or olive oil. The dry peas of the better varieties of peanuts contain about 45 per cent. oil and home samples have run as high as 54 per cent. The commercial oil is obtained by grinding and pressing the nuts or the shelled kernels. The best quality of oil is obtained from shelled peas which have been sorted by hand, blanched and degermed before grinding. The inclusion of a few rancid peas will render a large quantity of oil unpalatable.

Peanuts make an excellent food for stock, but, because of the high percentage of fat and protein contained, they should be combined with starchy feeds, such as corn or sweet potatos in order to produce a balanced ration. The same is true of the cake or meal left after the oil has been expressed. Peanut vines are readily eaten by hogs, cattle and horses. Even the dry hulls have some food value and may be used for roughage in feeding cattle. SPENCER and BROWNE give the following analyses for various peanut products in Florida :—

Vines	13·5	36·3	15·1
Nuts	20·4	16·4	36·2
Kernels	26·8	17·5	44·9
Meal from kernels ...	47·6	23·7	8·0
Meal, hulls included ...	28·4	27·0	11·1
Hulls	7·3	18·9	2·6

Peanuts have been tested as stock feed in competition with other grain and forage crops at many of the Southern experiment stations, and all published results show peanuts superior to any other crop. "The peanut vine and peas, when chopped or ground together, form almost a balanced ration for a dairy cow." Horses and mules are better nourished when fed entirely on peanut plants (vines and nuts) than when fed the usual ration of hay and grain. In Florida they found that "in comparison with other pasture crops, when one half ration concentrates was fed; one acre of peanuts fed 10 hogs 53 days; one acre of sorghum fed 10 hogs 46·6 days; one acre of soy beans fed 10 hogs 34·4 days; one acre of chufas fed 10 hogs 32·2 days." In Arkansas they produced 313 pounds of pork on a one-fourth acre plot planted with peanuts, while from another plot of the same size planted to corn they realized only 109 pounds of pork.

The peanut has been very much neglected in Hawaii. It has been grown enough, however, to show that it is a crop, well adapted to our conditions. There are hundreds of acres of land now practically idle in Hawaii that fulfil the requirements of this crop, yet during the year 1916 Hawaii imported 194,264 pounds of peanuts at a cost of 6,833 dollars.

During the winter of 1910-11 we grew four varieties of peanuts at the Experiment Station at Honolulu. The seed was obtained from a dealer in New Orleans under the names of Red Tennessee, White Virginia, Mammoth and Spanish. They were all harvested 170 days after planting. The White Virginia made the best growth, suffered least from insect and fungus attacks, and yielded the greatest weight of nuts. We obtained 17½ quarts of cured nuts, weighing 10¾ lb. from one 70 foot row. MR. F. G. KROUSS, who has grown peanuts for several years in Hawaii, now recommends a variety known as the "improved Valencia" as superior to all others under our conditions.—(*Reprinted from the Hawaiian Planters' Record in the Fiji Planters' Journal*, Vol V., No. 49.)

SAFFRON.

As *Saffron* is so often confused with turmeric (from the root of which we obtain the common condiment of that name) the following note may prove of interest :—

Saffron belongs to the same family as the *Crocus* and bears flowers with a deep mauve corolla, orange stamens and scarlet pistils.

In Kashmir, where saffron is a State monopoly, the fields present in early November great sheets of purple bloom which in the distance resembles heather.

At harvest time cloths are spread on the ground and the flowers are collected and dried on them.

When free from moisture the flowers are turned and shaken repeatedly to detach the pistils which are the only parts of the flowers that yield the saffron of commerce.

The dried blooms are next put into water which enables the pistils to be separated from the rest of the flower, since the pistils sink while the rest of the flower floats.

After removal of the parts of the flower that float the water is passed through a muslin strainer and the pistils collected and dried.

By this crude process there is much wastage since a good deal of the scented golden yellow dye yielded by the red pistils is either dissolved out by the water or caught up by the sheets.

Sometimes the pistils alone are picked, but this method though less wasteful is more expensive.

Dried pistils, ready for extracting the dye, are sold on the spot at Rs. 2/- per tola (Re. 1/- weight.)

C. D.

CURRY-STUFFS.

An officer of the Ceylon Agricultural Society who visited Welimada recently states : " I had the opportunity of seeing samples of the following *caddy* stuffs locally raised : Fenugreek, coriander and aniseed. The stuff was quite up to the standard of what is obtained in the market. It is felt that the fact that these crops can be profitably grown in the district is not sufficiently known." The following figures from an actual cultivator in the district are given :—

	Extent Sown.	Quantity Sown.	Yield.
Coriander ...	24 × 18	1 lb.	8 lb.
Fenugreek ...	do.	½ lb.	14 lb.
Aniseed ...	do.	¼ lb.	12 lb.

SOILS AND MANURES.

THE CONTROL OF IRRIGATION ACCORDING TO THE PHYSICAL PROPERTIES OF SOILS.

SUMMARY OF RESEARCHES BY MUNTZ AND LAINE.

H. HITIER.

From 1905 to 1910 MESSRS. MUNTZ and LAINE were engaged upon a series of researches, conducted both in laboratory and field in various parts of France, on the capacity of soils to utilise irrigation water and the most favourable conditions of distribution of this water.

The writer points out the value of such a study and the importance of knowing how best to use and to draw the maximum amount of profit from the invariably limited amount of irrigation water. Unfortunately, death has interrupted the course of the work. The results already obtained, however, are of great importance and it is to be hoped that others will carry on the research.

MESSRS. MUNTZ and LAINE have shown that it is indispensable to include, among the preliminary plans of an irrigation scheme, a study of the physical properties and particularly of the permeability of the soils contained in the irrigation area. They have shown that, contrary to generally received opinion, soils even of similar geological formation show enormous differences among themselves in this respect. They conclude the account of their 1905 to 1907 experiments in the following manner :

Apparently, soils can be divided into 3 categories :

(1) Those which can be regarded as almost impermeable, that is to say in which the water only penetrates a few millimetres in an hour and which, consequently, are not capable of allowing water to penetrate in ordinary irrigation conditions. In the authors' opinion, therefore, these soils are only worth irrigation in quite special economic and technical conditions.

(2) Slightly permeable soils, which the water, in the ordinary conditions of practical irrigation, can penetrate at about the rate of 1 cm. per hour and which would be suited by light irrigations repeated more or less often.

(3) Soils which the water penetrates to a depth of a few centimetres or more and which may be regarded as permeable, that is to say readily absorbing water and meriting heavier irrigation. Above a certain degree of permeability there is no longer any object in determining the exact degree to which the soils belong in the scale. Such soils are all capable of absorbing sufficient water. At this point there intervenes the determination of the amount of water actually useful to vegetation in order that it should be just this amount which is administered and not the undoubtedly greater quantity that such soils are capable of absorbing.

After 1908, MESSRS. MUNTZ and LAINE gave their researches another trend, devoting their chief attention to organising irrigation tests in different localities and in different classes of soils in order to discover the method of irrigation which gives the best effect on the crops.

Practical value of such researches.—The experiments made in the district of the Bourne Channel (Department of the Isère) show the practical scope of such researches. The Bourne channel, the Bourne being a tributary of the Isère, waters the plain situated on the left bank of the Rhône, to the south of the junction of this river and the Isère. The soils of this region are extremely permeable. According to the scale of MESSRS. MUNTZ and LAINE* this permeability varies from 30 to over 150, whilst soils of average permeability have an index varying from 5 to 20.

The water is led on to the land through narrow trenches which are dammed in order to make them overflow. When, as in the case in question, the permeability is very great, the process of infiltration is extremely rapid and unless the overflow is of considerable volume it only reaches the points closest to the trench. It then happens that a portion of the plots derives no benefit from the irrigation, whilst the soil near the trench is washed out by an excess of water ; the soluble fertilising elements are carried off into the subsoil and are lost to the plants, whence the paradoxical result: the irrigation diminishes the fertility.

Further, the head of water supplied to the user at the highest point of his property is too small for the canal in question, with the result that in view of the permeability of the soil, the speed of the water is insufficient to allow of its reaching points any great distance away. The water is also too clear to allow of the permeability being diminished by means of the deposit of matter in suspension.

Good results may be obtained from the irrigation, however, if, in spite of the small water supply, sufficient rapidity can be imparted to the flood water to allow of the plots if shortened, receiving water over its whole surface without the land around the supply trench receiving an excess.

Permeability of soils and their capacity to benefit by irrigation.—The best results have invariably been obtained in soils of average permeability.

When contemplating an irrigation project, a study of the physical properties of the soil is absolutely indispensable and it is particularly necessary also to determine the quantity of water permeating in a given time.

When this is done, soils may be classed in two great categories :

(1) Those possessing a degree of permeability corresponding to the two extremes of the scale ; these extremes forming exceptions though occurring fairly frequently ;

(2) Soils of average permeability.

In these latter, irrigations regulated according to the degree of permeability give remunerative results, that is to say barring exceptions independent of the nature of the soil.

In the case of the former, on the contrary, success is uncertain and before proceeding with the project it must be first considered whether the increase in yield is likely to be such as to compensate for the expense, which

* Each degree of the scale constructed by MESSRS. MUNTZ and LAINE, corresponds to a 1 cm layer of water permeating in an hour.

may necessarily be considerable. In soils of low permeability, in which the water penetrates at the rate of 1 to 2 mm. per hour, it may be advisable to anticipate a careful arrangement of the land; regular slopes with sufficient drop which would not allow any surplus water to remain on the land, and sometimes even draining. In highly permeable soils in which the water penetrates at the rate of more than 40 to 60 cm. per hour, expenses may be equally high, especially with exaggerated wages to labour. With these extreme types of land, when channels already exist it is advisable to turn them to account as much as possible.

In the case of very permeable soils a big volume of water is required at the head, the rapidity of the irrigating water being increased and the land divided into plots of small area.

For soils classed at the other end of the scale, the pressure of water at the head should be just sufficient, thus allowing the section of the laterals to be reduced; the speed of the irrigation water should then be reduced and the length of the plots increased.

General results of 1908, 1909 and 1910 experiments.—The quantity of water supplied by the irrigation is expected by what is known as the *débit continu* (continuous supply). This is the volume of water given during the growing period related to an area of 1 hectare (2·4,711 acres) and a time-period of 1 second.

The *débit continu* is the resultant of 3 dimensions:

(1) The pressure at which the water is supplied to the plot by the ultimate branchings of the channel.

(2) The duration of each irrigation.

(3) The period of elapsing till the next irrigation.

The experiments of MESSRS. MUNTZ and LAINE were conducted in order to fix these data. They were only concerned with natural meadowland irrigated by the flooding method. The experimental fields varied as widely as possible both as regards nature and permeability of soil. Both the volume of water and the intervals between irrigations were made to vary and the influence of such variations on the crop yield determined.

The experimental fields were classed as follows, according to the authors' own scale:

		Permeability.
Fourcadel		0·5 to 0·1
Ondes		0·6
Cheval-blanc (near Cavaillon)		2·0
Carpentras	Pernes-Garrigue	3·0
	Carpentras-Terradou ...	10·0
	Hernes-Croix-Couverte ...	12·0
Valence...		50 to 60

The following data were determined in each field:—

(1) the "module" or head of water at highest point of property;

(2) the quantity of water which had the most favourable effect upon the crop yield, with irrigations at identical intervals;

(3) the influence on the yield of a same total quantity of water distributed in smaller or greater amounts at more or less frequent intervals.

I. The "*Module.*"—The "module" (head of water at highest point of property) is equal to the product of the volume of the flood water and the width of the plot to be flooded.

The volume and speed of the flood water should vary between wide limits according to the rapidity with which the water penetrates, and should increase with the increase of this latter. The experiments have shown that, in very slightly permeable soils, like those of Fourcadel or Ondes for example, the "module" should be such that the capacity of the irrigation flood should be about 0·30 of a litre per metre of width per second; in soils of average permeability, as at Carpentras, it should be equivalent to a capacity of 1·5 to 2 litres per metre, per second; in lands of extreme permeability, such as those watered by the Bourne channel, it should exceed 9 litres per metre, per second.

In order to water more rapidly and to diminish labour the beds should be given the maximum width, still this width must not be exaggerated, otherwise it will make regular distribution of the water difficult.

II. *Quantity of water to be distributed at each flooding.*—The trials have shown that the amount of water to be employed should be just sufficient to allow of its reaching the extremity of the bed.

A quantity of water in excess of this represents a loss and might be employed for watering other surfaces; it might also be actually harmful owing to its washing out the soil and carrying off nutrient matter. If, in some cases, more plentiful watering gives a slight increase in the crop yield, this increase is not proportional to the extra cost of the water.

III. *Intervals between floodings.*—Generally speaking, the best results are obtained with irrigations repeated every 7 or 8 days.

Floodings at very close intervals often give an increased crop but this increase is neither sufficiently uniform nor important to compensate for the extra cost of labour.

Floodings at intervals of a fortnight and, especially of 3 weeks, give markedly inferior results.

Water Supply.—Hitherto it has been held that the normal supply should be equivalent to 1 litre per hectare per second, for all lands. MESSRS. MUNTZ and LAINE have now found that, varying with the nature of the land, the correct supply should be as follows:

Fourcadel	0·23 litres instead of	0·75	litres	as fixed by agreement.
Ondes	0·64 ,, ,,	0·75	,,	not fixed.
Cavaillon	0·55 ,, ,,	0·75	,,	not fixed.
Carpentras	0·71 to 0·85 ,,	1·275	,,	as fixed by agreement.

This proves that wastage usually occurs.

MESSRS. MUNTZ and LAINE add that the ideal irrigation would be one which supplied the soil with the quantity of water strictly necessary to obtain a maximum crop. In experiments at the Meudon Station of Plant Chemistry, the amount of water evaporated which corresponds to 1 kg. of dry crop, never

exceeded 550 litres. According to this, there would be required for the plus crop values obtained by irrigation, the following quantities of water.

		Plus-value of crop.	Quantity of water. Evaporated by the crop, cubic metres.	Usually given, cubic metres.
Stations	Fourcadel	2700	1485	5880
	Ondes	3500	1925	3500
	Carpentras	10000	5500	20700

The quantities usually given are consequently greatly exaggerated. One must take into account, however, that irrigation channel must respond to the calls made upon it at times of greater drought. If a fresh calculation is made for a second crop (aftermath) during a similar period, the following figures are obtained :

		Plus value furnished by the irrigation kg.	Number of floodings.	Volume of water per flooding. Usually given cubic metres.	Utilised by the plant, cubic metres.
Stations	Fourcadel	2200	6	490	202
	Ondes	2225	4	500	306
	Carpentras	4330	8	830	298

These data, though of a somewhat abstract character, show that the real water requirements are markedly exceeded in practice. Although it is impossible to obtain the ideal quantity in practice nevertheless efforts should be made to approximate to it.—BULL. INTERNAT. INST. OF AGRIC. Year viii., No. 7, July 1917.

LIMING AND LIME REQUIREMENT OF SOIL.

J. W. AMES & C. J. SCHOLLENBERGER.

The work of others bearing on the subject is briefly reviewed, and data obtained from several years' study of fertility plots under various conditions of liming and treatment and the results of certain pot experiments are reviewed and summarized.

It was found that, "the chemical composition and mechanical condition of lime materials are probably of primary importance in relation to speed of reaction with soil, rate of loss, and usefulness as soil amendments. The comparatively small amount of carbonate residual from applications of various lime materials after relatively brief periods indicate that the speed of reaction with soil of commercial lime materials is of a high order. From data obtained for a silt loam soil quite deficient in basic material and receiving different accounts of ground limestone under normal conditions, it can be considered that under similar conditions 70 per cent. of the calcium supplied by a moderate application of limestone—say 2 tons per acre—will have left the carbonate form within a year. From heavy applications—6 to 13 tons per acre—the percentage of calcium and magnesium combining with the soil and the proportion carried downward and lost are less when referred to the total amount applied, but, expressed as pounds per acre, the quantities are really greater than those from smaller applications. . . .

"With regard to the effect of fertilizer treatment upon carbonates residual from applications, it was found that ammonium sulphate was capable of accelerating the decomposition of carbonates, and is the only fertilizer in common use the effects of which in this direction are unmistakably apparent. In distinction from ammonium sulphate, a physiologically acid salt, sodium nitrate, a physiologically alkaline salt, appears to have a general tendency toward the conservation of carbonates."

Manure appeared to exert an influence toward the conservation of carbonates. Of the bases added and not accounted for by the presence of carbonates, a considerable proportion was retained by the first 12 in. of soil. The unfertilized plots retained much less than the average of the fertilized. The differences in amounts of bases retained in form other than carbonate by the fertilized plots were not great. The soil of the lime extension plot to which were applied 6 and 13 tons of limestone per acre with and without manure retained more calcium and magnesium in the first 12 in. than the soils from five-year rotation plots, although not by any means a proportionate amount. The bases retained were mainly in the first 8 in. but increases were apparent as deep as the samples were taken (24 in.). The manure appeared to have caused increased fixation of calcium by the soil and to have had a tendency toward equalizing its distribution in the several depths sampled. Leaching was the most important source of loss of carbonates and basic calcium.

Very coarse limestone (1/3 to 1/20 in.) is probably of little value unless applied in excessive amounts. In general, dolomitic stone ground to different degrees of fineness and applied to the soil suffered a less degree of decomposition than corresponding applications of a higher calcium stone. Crop yields from small plots gave no consistent indications of superiority for either form of stone. Soils containing water-soluble acid constituents in determinable quantity were rarely encountered.

"The litmus paper test, when carefully conducted and intelligently interpreted, is probably as good as any chemical test for the determination of the soil's need of lime. All the lime requirement methods tried indicated marked differences between limed and unlimed soil of the same character and treatment, and all, except the Veitch method, loss in bases due to a long period of cultivation.

"The data available indicate that the vacuum method is the best adapted of the procedures tested for use as a quantitative method in studying the relations between the soil and its supply of bases. There is no evidence that any of the lime requirement methods tested furnished reliable indications as to the optimum rate of application for field practice. For the several soils investigated, there was found to be an approximately quantitative relationship between the bases soluble in fifth-normal nitric acid (excluding carbonates) and differences in lime requirement by the vacuum method.

"Acidity of soil, as the term is usually employed, is a negative property; that is, due to qualities inherent in all soils, but manifested only by those deficient in basic constituents. Too much emphasis has been laid upon soil acidity, and the more important theme, soil basicity, has been neglected.

"Calcium and magnesium are retained in the soil mainly as silicates, possibly partly in combination with organic matter.

"Field tests show that the yields of clover on plots treated with acid phosphate have been less than on plots where bone meal and basic slag were used as carriers of phosphorus. The evidence obtained by laboratory studies, however, does not indicate that acid phosphate has any important influence toward the depletion of the soil's supply of bases; effects due to the acid nature of this fertilizer are insignificant when compared with those attributable to the use of ammonium sulphate.

"Dried and green crop residues mixed with soil did not increase its lime requirement as determined in the laboratory. Field observations and tests made do not indicate that organic matter furnished by green crops causes acidity in soil. A mulch of fermenting material (apple pomace) caused the lime requirement of the soil beneath to be increased. Sawdust similarly used had little effect.

"Pot experiments indicate that the base of various silicates, including blast-furnace slag, may be of benefit to crop growth.

"Lime requirement determinations on samples taken at various depths of a lime soil indicate that the effect of lime applied is perceptible to a depth of 24 in. or more.

"Unusual weather conditions to which the soil may have been exposed in the field have had no great effect upon the lime requirements as determined in the laboratory."—EXPT. STN. RECORD, VOL. 37, NO. 2, August, 1917.

TOO LITTLE OXYGEN OR TOO MUCH CARBON DIOXIDE?

Recent researches summarized or reviewed in this Journal appear to show that the oxygen supply in the soil can and does become a limiting factor in the growth and yield of crops.

Since the work of nitrifying organisms in the soil is, generally speaking, known to be promoted by the same factors as forward the growth of plants, it is interesting to know whether the oxygen supply of the soil ever becomes under such conditions so low as to effect detrimentally the bacterial activities in question.

GAINEY and METZLER (JOUR. AGRIC. RESEARCH vol. xi. No. 2. p. 43) have studied "Some Factors affecting Nitrate-Nitrogen in Soil" and in discussing their results summarize the data available on the effect of different degrees of æration upon nitrate formation. It is concluded that "the oxygen content of the soil atmosphere can be reduced to one-half normal atmospheric oxygen content or below without any appreciable effect upon the processes."

Is there any probability that sufficient quantities of oxygen will not be available under field conditions?

Recent researches upon soil gases are reviewed amongst which is LEATHER'S work upon soil gases at Pusa, India (cf. MEM. DEPT. AGR. IND., CHEM. SER., Vol. iv. No. 3) and the conclusions arrived at are that "the percentage of oxygen contained in the free soil atmosphere is normally only slightly below that in the atmospheric air." Even several feet below the surface where the soil has never artificially been disturbed the percentage of air by volume in soil rarely ever falls below 20. Such exceptional reductions

may be caused by heavy monsoon rains, by excessive trampling of cattle, by heavy applications of green or stable manure as well as the presence of certain growing plants. The carbon-dioxide content of the soil, however, is usually higher than that of the atmospheric air. The proportion rarely ever exceeds 2% and usually is only "a few tenths of 1 per cent." Owing to the greater solubility of carbon dioxide, the dissolved soil air usually contains a large proportion of this constituent which LEATHER suggests as being probably in loose chemical combination as an acid carbonate.

These show that biochemical activity in the soil will rarely be affected by an insufficient oxygen supply. It makes one also to inquire whether HOWARD's set of phenomena recorded ought to be explained by an excessive supply of carbon-dioxide rather than an insufficient supply of oxygen. HOLE in his researches on Sal (*Shorea robusta*) seedlings could not definitely say whether the growth and development of these seedlings were affected by an injurious factor as the carbon dioxide supply or a limiting factor as the oxygen supply. The fact that the carbon dioxide content of the soil air increases at the expense of oxygen complicates the issue.

According to LEATHER, the beneficial effect of cultivating the soil to whatever factor or factors it may be attributed cannot be attributed to increased æration. GAINEY and METZLER, in the paper above mentioned, sum up their results by saying "We do not believe, however, that one is justified in attributing the major effect of cultivation upon nitrification to better æration. There is no question but that cultivation may beneficially influence nitrate formation other than through increasing æration."

RUSSELL and APPLEYARD (JOURN. AGRIC. SCI. vol. iii. Pt. 3 p. 315) show in their studies of the decomposition of organic matter in the soil that a growing crop exerts a depressing effect on biochemical activity. The investigations that are in progress will attempt to make it clear whether this is due to the crop taking up the dissolved oxygen that the bacteria need, or to an excessive formation of carbon-dioxide or to other causes.

H. L. VAN B.

FERTILIZATION OF RICE.

C. BALANGUE Y. RULLODA.

Fertilizer trials are reported with upland and lowland rice at three centres in the Philippines, using wood, grass, and rice ashes; stable manure; acid phosphate; ammonium sulphate, and lime. The results obtained from the various fields are reported in tabular form and discussed. Simple systems of fertilization of both upland and lowland rice were found profitable. Stable manure proved to be the best of the locally available fertilizers, with ashes next, and a combination of stable manure and ashes giving good results. Liming increased production, especially on the "old" fields.—EXPT. STN., REC. VOL. 37. No. 4, September, 1917.

CO-OPERATION.

WORKING OF SOCIETIES, CEYLON, IN 1916-17.

WESTERN PROVINCE.

Colombo District.

Minuwangoda Society (registered January, 1914) continues to make satisfactory progress, and is the most successful society in the district. During the year under review a large quantity of manure was distributed through the society. Through the activity of this society two other societies were started in the korale (Alukuru korale north). A large measure of the success of this society is due to the interest taken by the President (MUDALIYAR SAMARAKODY) and the energetic Secretary (MR. D. M. P. R. SENANAYAKA). This Society has proposed to open an experimental garden, and this is now under consideration.

Kalapaluwawa Society (registered October, 1914) has shown good progress. Its area of operation extends only to one village. The keen interest shown by its President (MR. ADVOCATE BOTEJU) and the Treasurer (MR. S. F. AMARASINHA) has contributed to the success of the society. The society received a small loan from Government and paid its first instalment. Its meetings are regularly held, and "these meetings were always preceded by informal meetings of the members, at which addresses were sometimes given and articles from the 'Govikam Sangarawa' read," says the Secretary in his annual report. This is the only society which compelled the members to make a saving by a small monthly deposit.

Udugaha-Meda Depathuwa Society (registered September, 1914) is making some progress in spite of many obstacles. Sufficient support from the President and Vice-President is lacking, but the Secretary and the Treasurer and a few of the Committee have worked conscientiously for the welfare of the society.

Aturugiriya-Kottewa Society (registered February, 1914).—Progress is slow. Its members evinced great interest in the matter of manuring paddy, coconut, vegetables, and even betel. This has been a means of enrolling new members. If the society holds its meetings more regularly, the society will show better progress. The society also participated in the co-operative purchase of implements.

Henaratgoda Society (registered September, 1913) has been slack in holding its meetings and in its business transactions. This society, which had a good start, should now take a lesson from its neighbour, the Minuwangoda Society, and keep pace with it.

Gangaboda Pattu of Siyane Korale East Society (registered June, 1914) has not yet recovered from the effects of the riots. The Organizing President had to sever his connection with the Government, and the Vice-President was transferred from the district. The newly-appointed Muhandiram of the

korale was appointed President of the society, but until he has settled down progress is not to be expected. With the assistance of a good Secretary the society ought to progress.

Dakunu Talangama Society (registered July, 1914) has already shown what a village society can do. It has made a very satisfactory start as regards the number of members, its paid-up capital, and the volume of business done within this period. This society was started on the initiation of the Treasurer of the society, who is also Secretary of another society.

Godakaha Palata Society (registered March, 1916) was started as a result of the good work being done by the Minuwangoda society. The Head Teacher of the Hunumulla School, who is the Secretary of the society, takes a great interest in the work. MUDALIYAR SAMARAKODY is the President.

Siduwa Society (registered July, 1916) is another outcome of the good work being done by the Minuwangoda society, and the same MUDALIYAR is its President. It must be stated to the credit of REV. J. S. B. MENDIS, who is the Secretary of the society, that the prospects of the formation of a Society in this centre became brighter since his co-operation was promised. MUDALIYAR A. E. RAJAPAKSA has donated a sum of money to meet the initial expenses of the society, and has also offered to deposit Rs. 1,000 without interest as soon as the society has collected an equal amount as its paid-up capital.

Colombo Plumbago Employees Society (registered July, 1916) was established by the Ceylon Social Service League, and proposes to assist a very deserving class of people, the employees of plumbago stores within the Municipality of Colombo. The Society took a considerable time to get into working order, but it has made a start. The society has before it a great and useful field of work for the amelioration of the condition of the people for whose benefit it was started.

Jayawardenepura Kotte Society (registered March, 1915), started with the Muhandiram of Salpitikorale as President two years ago, has done nothing beyond collecting share money from a few members.

Kosgama-Kalugala Society (registered March, 1915) was started by the late Muhandiram of the Hewagam korale at the request of a few headmen. The Muhandiram had to leave the place, and the others do not take any interest.

Kalutara District.

Kumbukke Pattu Society (registered March, 1914) is a very progressive society. It holds its meetings regularly, and is carrying on its business satisfactorily. Members understand their business, and look upon the society as a great asset. Hardly any loans become overdue. The Secretary ungrudgingly attends to all the clerical work of the society. This Society received a loan of Rs. 1,000 from the Government

Adikari Pattu Society (registered June, 1914) was started about the same time, and works on the same lines as the last. The Secretary of this society is also enthusiastic, and attends to the work in a satisfactory manner. A few members, through a misunderstanding, had to withdraw from the society. There are a few more who do not understand the importance of punctuality in repayment of loans. The society declared a bonus of 8 per cent. this year against 12 per cent. last year, being profit accumulated for three years.

Handapangoda Society (registered October, 1913).—Last year's progress has been continued, and the work of the society has increased in all directions. The village headmen who did not join the society at the beginning are now joining. This society declared a bonus of 25 per cent. after carrying a very satisfactory amount to the reserve fund. The affairs of the society are managed by the villagers themselves, with the help of the schoolmaster, who is the President of the society.

Galpatha Society (registered March, 1914, is the fourth society in the korale, and has not progressed so satisfactorily as the other societies have done. The members are now taking an increased interest in the society.

Haltota Society (registered July, 1916), the fifth in the korale, established only recently, is making very rapid progress. It has collected a satisfactory sum as paid-up capital, and the affairs of the society are conducted in a satisfactory manner.

All these five societies are situated in Rayigam korale, and were started by the Mudaliyar of the korale, GATE MUDALIYAR WIRASINHA, who takes a very keen interest in them. In each of the societies the village schoolmaster as Secretary assists the society. It may be mentioned here that the example set by this Mudaliyar is slowly bearing good fruit in other korales. All the five societies deal in manure, the value of such co-operative dealings having been fully realized by the members.

Maha Paltu North Society (registered September, 1916) was started in August last by the Mudaliyar of Pasdum korale West, and has made a good start. With a good Secretary this society ought to prove its usefulness to the villager.

Mahagama Society (registered September, 1916) started about the same time by the villagers of Mahagama, with the advice of the Mudaliyar. Its working became slow owing to the continued illness of the Secretary. A new Secretary has since been appointed.

Panadure-Talpitibadda Society (registered March, 1917), the latest society to be started in the district, is organized under the presidency of the Totamune Mudaliyar, and has secured the services of a good Secretary, and there is every prospect of its doing good work.

CENTRAL PROVINCE.

Kandy District.

Harispattu Society (registered July, 1913) was the first to be started in the Province, and as it has not justified its existence, steps have been taken to cancel its registration.

Udagampaha Society (registered February, 1914), with the loss of the assistance of its founder, the late MR. N. P. CAMPBELL, of the Social Service Union of the Trinity College, is at a standstill. Unless the society is revived, its continuance will be of no use.

Galagedara Society (registered November, 1913) had a good start, but no progress has subsequently been made. If sufficient co-operation were to be rendered by the Chief Headman of the division, it would prove a useful society.

Uda Dumbara Society (registered September, 1914) is making a very poor progress. The society started with a very large area of operation, with the

purpose of making it a big society, but the riots interfered with its working, and the organizers, the Secretary and the President, were somewhat disappointed at the results.

Hataraliyadda Society (registered October, 1914) showed very rapid progress at the beginning, but owing to various reasons deteriorated later. It is a pure village society, and the villagers are very keen about it. The society's work has recently been revived.

Uduwawela Society (registered October, 1914), of which great progress was expected, proved disappointing, and the work has come to a standstill. Its future will have to be considered.

Kandyan Association Society (registered December, 1916), started only a few months ago, is expected to give a stimulus to the spread of the co-operative movement in the Kandyan districts. It has a number of energetic and enthusiastic young men as members, and has opportunities for good work.

Nuwara Eliya District.

Walapane Society (registered September, 1913) is the best society in the Kandyan districts, RATEMAHATMAYA ALAWATUGODA has continued to take an interest in the society, which is making a good progress. Some of the members have repeatedly failed to pay their loans at due dates. This matter is receiving attention. The society paid its second instalment on account of the Government loan, with interest due. After setting apart the required amount for the reserve fund, it declared a bonus of 3 per cent. for this year against 4 per cent. last year, being accumulated profits for the first three years' working. The opening of an experimental garden and the holding of a village agricultural show are receiving the attention of the society.

Uda Hewaheta Society (registered October, 1913), met with various difficulties, and the good work started did not bear fruit. The Organizing President resigned, and the new Ratemahatmaya of Uda Hewaheta was appointed President in his place and has taken charge of the society's affairs.

Matale District.

Nagolla-Hulangamuwa Society (registered September, 1914), makes very satisfactory progress since the appointment of the new Secretary and the Treasurer, both of whom have ably assisted the President. Among various other matters, the society proposes to undertake the establishment of an experimental garden. The co-operative purchase of produce from members is also another subject which is receiving the attention of the society.

Udugama-Dombawala Society (registered February, 1915) has done nothing beyond registration, and no credit will go to those who initiated the society.

SOUTHERN PROVINCE.

Galle District.

Talpe Pattu Society (registered September, 1913) is the best working society in the district. The President of the society, MUDALIYAR GOONETILLEKE, and the Secretary, MR. SENEVIRATNE, are taking very great interest in its working. It has been the source of opening out new village lands for food and other agricultural products, and has been helping quite a number of cultivators to this end. Its working is very methodical. With more help the society's scope can be enlarged.

Wellaboda Pattu Society (registered November, 1912).—The first to be registered under the Ordinance, and the thanks of the people should go to its founder, MUDALIYAR J. P. GUNATILAKE. But for the unsatisfactory Secretary, the society would have progressed much more. A new Secretary has been appointed, and the society's progress is assured.

Akmimana Society (registered June, 1913) is making slow progress. If the members of the Committee had taken a little more interest, the President and the Secretary of the society would have done better work.

Galle Gangaboda Pattu Society (registered June, 1913) though it does not show marked progress, is doing its work in a small way. The area of this society is too large, and a village society has already been established in the pattu.

Hinidum Pattu Society (registered November, 1913) suffered the loss of its Organizing President by his transfer, and the new Mudaliyar of the pattu has been appointed President in his place. The society recovered a number of overdue loans within the year, and has paid the first instalment of the Government loan which was taken at the end of last year.

Unanwitiya Society (registered February, 1917) was started by the villagers of Unanwitiya village, and has made a very good start. The society has appointed two Joint Secretaries. Both are enthusiastic workers. Its area of operation extends to a couple of hamlets in the neighbourhood. As a result of the working of this society, an interest is already evinced in the adjoining villages to start societies.

Matara District.

Kandaboda Pattu Society (registered October, 1913) has done the best and most systematic work in the district. Its work is progressing year after year. The success of the society is due to the interest taken by MUDALIYAR GOONERATNE.

Weligam Korale Society (registered December, 1912).—This society's good work started by the late President has revived since the appointment of the new President, MUDALIYAR ILANGAKOON, who has begun to take a lively interest in the working of the society. The first Secretary having resigned, another village headman who understands the working very well has been appointed as Secretary. In the hands of these two office-bearers the society is sure to do very useful work.

Hambantota District.

Magam Pattu Society (registered July, 1913) continues to do its useful work to the benefit of the cultivators. As a result of the activities of the society, the amount advanced to cultivators for an amunam of paddy has been increased by a rupee, which means a rupee gained by the cultivator, which is quite a good income for a season. It may be repeated here that MUDALIYAR AMERASEKERA, the President of the society, should be given more support to extend the scope of the society's work- MUHANDIRAM USUPH, the Secretary, is doing his work satisfactorily.

Giruwa Pattu Society (registered January, 1915) was lately revived, and a large number of members joined the society. With a new Secretary the society should start its working.

NORTHERN PROVINCE.

Jaffna District.

Uduppiddi Society (registered November, 1913) has continued to do its useful work very successfully. It is a model village society, which should be copied by others. The society declared a bonus of 5 cents per rupee share from its accumulated profits, after carrying the usual amount to the reserve fund.

Tellipalai Society (registered August, 1913) was revived, and a new President and Secretary were appointed in August last. Since then it shows progress.

Jaffna Industrial Society (registered August, 1914), the only one of its kind in the Island, continues its work in a small way. The society's usefulness can be extended if its President and Secretary receive more outside support in the keeping of books and such other work. MR. B. HORSBURGH, the Government Agent of the Province, graced one of the meetings of the society, and spoke to the members in their own tongue. This was greatly appreciated, and has served as an encouragement to them.

Copay Society's (registered September, 1913) activities are very limited, and the interest taken by the Secretary is not recompensed by the amount of work done, However, with the appointment of the new President (REV. C. T. WILLIAMS) the society is expected to extend its work.

Jaffna Central Society (registered September, 1914) failed to realize expectations, and has done no work.

Pandatarippu Society (registered August, 1916) started in August last, has shown what a society with an energetic President can do. It not only raised a satisfactory capital, but also obtained a loan from Government. Its meetings are regular, and work is methodical. The success of the society is due to the interest taken by MANIAGAR SANDRASAGRA, the President, and also to the Secretary and Treasurer.

Karaveddi Society (registered September, 1916) was also started at the same time, and has also made satisfactory progress under the presidentship of MANIAGAR CHINNATAMBY. It was proposed to erect an irrigation pump for the benefit of the members, but the project has had to be kept back for the present. The loan applied for by this society from Government was also granted, but the society postponed taking it until the next planting season.

Puloli Society (registered September, 1916) is another society worked by MANIAGAR CHINNATAMBY, but its progress is not so marked as that of the Karaveddi.

Valikamam West Headmen's Society (registered September, 1916) is confined to the headmen of the Maniagar's division, and is a useful institution. It has made a very satisfactory beginning. MANIAGAR SANDRASAGRA is the President of the society.

Annaikkoddai Society (registered September, 1916) is also a new society, with the GATE MUDALIYAR CHINNIAH as President. The society should show more activity by holding meetings regularly and enrolling more members.

American Mission Agents' Society (registered September, 1916) is the outcome of the efforts of the REV. WARD, of Manipay Mission. It proposes to assist teachers and other employés of the Mission in the Jaffna District who

are in need of financial help. The founder of the society, by his many years' experience, has seen the want of such an institution, which should in time to come prove of great benefit to its members. The society has had to overcome many difficulties before a beginning could be made.

Mannar District.

Nanaddan East Society (registered August, 1913) continues to lead the societies in the district in the matter of doing real good business. MR. EDIRAMANASINHA, Udaiyar, the Treasurer of the society, who has since been elected President, is mainly responsible for its progress. The number of members and the working capital are on the increase. The nominal capital of the society has been increased to double the original capital. The society proposes to apply for a loan from Government. MR. SEEMAMPILLAI, a passed student of the School of Tropical Agriculture, has been appointed Secretary, and has begun his work well.

Nanaddan West Society (registered August, 1913), with the Adigar, the Chief Headman of the division, as President, has failed to do anything after registration.

Mantai South Society (registered August, 1913, is in the same state as it was a year ago.

Mantai North Society (registered August, 1913) is somewhat better than the Mantai South Society, and with a little more perseverance can be made to work.

Mannar East Co-operative Fish Supply Society (registered July, 1916) was registered in June last, but did not proceed further, as its by-laws were not acceptable under the Ordinance.

NORTH-WESTERN PROVINCE.

Kurunegala District.

Hiriyala Hatpattu Society (registered October, 1913) is doing its work steadily under the presidentship of the Chief Headman of the division, RATEMAHATMAYA TENNEKOON. This is the only society in the district.

Puttalam District.

Puttalam Society (registered April, 1913) revived its work in April last, and is doing business now. It would have done better, if not for frequent changes of the President and other office bearers. Of the two Sub-Committees, that for Demala hatpattu is making good progress.

PROVINCE OF SABARAGAMUWA.

Ratnapura District.

Kadawala Korale Society (registered January, 1914), is the only society registered in the district, and it failed to perform anything beyond registration. The registration of this society will have to be cancelled.

Kegalle District.

Galboda and Kinigoda Korales Society (registered March, 1913) has started its work with earnestness after many months of stagnation. Difficulties were overcome by the efforts of RATEMAHATMAYA BOYAGODA, and with the assistance of the present Secretary the Society will continue to work.

Three Korales Society (registered September, 1913) has not made any progress for the last two years. The share capital collected at the start is lying idle in the Post Office Savings Bank.

NORTH-CENTRAL PROVINCE.

Anuradhapura District.

Anuradhapura Society (registered February, 1915) lost its original President and Secretary, and as a result its work was retarded. Early this year its work was revived, a new President and Secretary being appointed. Since then the society is doing some useful work.

Tamankaduwa Society (registered October, 1913), has not justified its existence, and steps will have to be taken to cancel its registration.

EASTERN PROVINCE.

Batticaloa District.

Batticaloa District Society (registered October, 1913), since it lost its original President and Vice-President, does not show any activity, and the society is almost defunct.

Tampiluvillu Society's (registered October, 1913) registration will have to be cancelled.

PROVINCE OF UVA.

Badulla District.

Uva Society (registered September, 1913) lost its Secretary by the transfer of MUDALIYAR AMARASEKERA to another station. In his place MUDALIYAR ABEYWARDENE has been elected Secretary, and the society's work was revived.

Makulla Society (registered December, 1913) is making satisfactory progress. The society has a large number of members, and the paid-up capital is not sufficient to meet all the requirements.

Medagama Society (registered December, 1913) is also working satisfactorily, but it is not so progressive as the Makulla society. It also has a large number of members.

Bibile-Nilgala Society (registered January, 1915) has made a good start. It has enrolled a good number of members, and has given a number of loans. MR. C. W. BIBILE, a very successful student of the School of Tropical Agriculture, has been appointed Secretary of this society. The above three societies are situated in the Wellassa district, and are doing quite useful work. The villagers, who were persuaded to become members through the influence of RATEMAHATMAYA BIBILE, President of all the three societies, have now come to realize the usefulness of the societies, and are very keen on becoming members. If the societies have sufficient funds to enlarge their work and to meet the demand of every member, the societies will without doubt go a great way to redeem these poor villages from their present unsatisfactory situation. The societies have saved a large amount of money from going as interest to usurers, who usually charge very exorbitant rates. It is usual for the villager to borrow a rupee or 75 cents at the time of sowing and to give in exchange a bushel of paddy or kurakkan, which when sold will realize Rs. 2. The societies now lend money—each member's requirements now being more than Rs. 10, and not less than Rs. 3—at 12 per cent. per annum, that is, the member pays only 6 cents as interest on a rupee for the same period, instead of a rupee.

N. WICKRAMARATNE,
Secretary, Board of Control, Co-operative Credit Societies.

THE RATE OF CO-OPERATIVE PROGRESS IN DIFFERENT PARTS OF INDIA.

Under the above heading a very useful and interesting article appears in the June number of the "Bombay Co-operative Quarterly" by the pen of MR. R. B. EWBANK, Registrar of Co-operative Societies, Bombay. MR. EWBANK deals with this difficult subject in an able manner and is fully qualified to handle it with his knowledge gained not only as Registrar of one of India's premier dependencies but also as the Secretary of the Committee on co-operation appointed by the Government of India under the presidency of SIR E. D. MACLAGAN.

The writer observes that nothing is more difficult than to establish a fair criterion by which the rate of progress in co-operation in various parts of India can be judged. All good co-operators are jealous for the honour of their own province and are disturbed when they find it lagging behind its rivals. Every province has its own strong points. Therefore it is not an easy thing to say which province has progressed more than the other. The Government of India publishes an abstract of progress annually in which (a) the number of societies, (b) the number of members, (c) Capital and disbursements are given as the four fundamental factors of progress and the writer of this article has taken these four factors as a reasonable form of progress with the provision that it should always be remembered that their value is relative and not obsolute. In this the figures of seven provinces of India viz:—Punjab, United Provinces, Central Provinces, Bengal, Madras, Bombay, Bihar and Orissa, and those of Burma and of the Native State Mysore are given. The figures quoted are those for 1914-15.

(a) The total number of societies in all these provinces is 16,325 which is distributed as follows:—Punjab comes first with 3,337 with an average of 16·7 societies per lakh of population. United Provinces comes 2nd with 2,962 with an average of 6·3 societies per lakh of population. Central Provinces, Bengal, Madras, Burma, Bihar and Orissa, Bombay and the Mysore State come next in order with 2,297, 1,992, 1,600, 1,489, 1,087, 836 and 725 societies respectively. And their averages are 16·5 societies per lakh of population in Central Provinces, 4·4 in Bengal, 3·9 in Madras, 14·1 in Burma, 3·1 in Bihar and Orissa, 4·3 in Bombay and 12·5 in the Mysore State.

(b) The number of members per society in each Province is as follows:—Bombay 103, Madras 74, Mysore State 73, Bengal 54, Bihar and Orissa 50, Punjab 47, United Provinces 40, Burma, 26 and the Central Provinces 20.

(c) The total working capital of all the Societies in all the Provinces is Rs. 9,87,94,700. Punjab comes first with Rs. 2,05,63,000 and the other provinces come in the following order, Madras with Rs. 1,68,88,000, Bengal Rs. 1,24,48,000, United Provinces Rs. 1,20,34,000, Burma Rs. 1,03,39,000, Bombay Rs. 90,66,000, Central Provinces Rs. 87,09,000, Mysore State Rs. 44,20,700 and Bihar and Orissa comes last with Rs. 43,27,000.

The following table shows the average working capital per society and per member in each of the Provinces :—

Name of Province.	Average working capital per society.	Average working capital per member.
	Rs.	Rs.
Bombay	9,775	91 6th place
Madras	8,880	123 4th ,,
Punjab	5,738	139 2nd ,,
Burma	5,586	221 1st ,,
Bengal	5,519	102 5th place in both
Mysore State	4,256	68 last ,,
United Provinces	3,966	90 7th place in both
Bihar and Orissa	3,359	70 8th ,, ,,
Central Provinces	3,143	132 3rd place.

" A fallacy lurks under the figures in the above statement showing the working capital per member because the working capital of Provincial Banks, Central Banks, and primary societies has been taken together in order to obtain these totals. The capital of the primary societies to which it is advanced and is therefore reckoned twice over in the provinces, like the United Provinces, which depend on a Central Bank system. Where there is also a Provincial Bank, as the Central Provinces and Bihar, the same capital frequently appears three times over." The writer has inserted the following statement to avoid this error and in order to show what is the actual amount of working capital available per head to members of primary agricultural societies, for whose benefit ultimately the whole system exists.

The working capital available per member in agricultural primary societies in Burma comes first with Rs. 130 and averages of other Provinces are as follows:—Punjab Rs. 105, Madras Rs. 74, Central Provinces Rs. 70: Bombay and Bengal Rs. 60 each, United Provinces Rs. 48, Mysore State Rs. 44, and Bihar and Orissa Rs. 39. Apart from these there are other factors which go to show the progress of Co-operation such as the amounts of Reserve, share capital, and deposits. The Committee on Co-operation insisted on the prime importance of all societies building up their own "owned capital" by increasing their reserves. MR. WOLFF is never tired of reiterating the importance of that and local deposits as the real basis of all genuine co-operation.

Punjab again comes first in the amount of deposits in the agricultural societies and with the total reserve fund with Rs. 24·53 lakhs and Rs. 29·10 lakhs respectively. The following are the figures of other provinces, Bombay Rs. 15·23 and Rs. 4·70 lakhs, Bengal Rs. 8·80 and Rs. 8·31 lakhs, Madras Rs. 7·78 and Rs. 8·06 lakhs, Bihar and Orissa Rs. 4·50 and Rs. 2·69 lakhs, United Provinces Rs. 2·63 and Rs. 9·90 lakhs, Central Provinces Rs. 1·48 and Rs. 3·77 lakhs, Burma Rs. 1·30 and Rs. 8·18 lakhs, and the Mysore State Rs. 1·14 and Rs. 1·59 lakhs respectively.

It will be seen from the above figures that of all the provinces Punjab alone maintains a high place in all the factors.

MR. EWBANK mentions that there are three main conditions for rapid progress of the movement. These are (1) a keen demand for cheaper credit for agriculture; (2) an educated peasantry, or failing that, strong educating and supervising agencies to control societies: (3) an organization which can ensure to village societies prompt and adequate finance. To these, he concludes, that a fourth should be added, i.e., the development cannot be rapid unless the controlling staff of the co-operative department is experienced and sufficient in number.

N. W.

CO-OPERATIVE SOCIETIES IN TRAVANCORE.

Co-operative societies have been started in Travancore for the first time in 1915 after passing of the Local Ordinance No. X of 1089 corresponding to April 1914.

The number of societies according to the first report of the Registrar of Co-operative Societies for the year 1915-16 were 26. Of these, 20 are credit societies 19 being rural credit and one central. Two of these credit societies fall under non-agricultural credit. Of the remaining 6 societies four are for purchase and sale, one for purchase and sale coupled with production and sale, and as well as credit and the remaining one for production and sale along with distribution and credit.

Members.—The total number of members of all the societies were 945 of which 16 were members of the Central Society.

Share Capital.—The total share capital collected during the year under review by all the societies was Rs. 13,537 of which Rs. 8,340 were collected by the Central Society, Rs. 2,670 by agricultural societies and Rs. 2,527 by the other societies.

Deposit.—Rs. 402 have been received during the year and deposit Rs. 213 have been withdrawn.

Reserve Fund.—A sum of Rs. 261 was lying to the credit of the Reserve Fund at the end of the year.

Loan from Government.—The State Government has advanced on loan a sum of Rs. 29,800 to the Central Society and the Central Society too issued loans to other societies.

N. W.

GENERAL.

BABUL: ITS COMMERCIAL VALUE.

The following note on Babul *(Acacia Arabica)* Willd. by J. D. MAITLAND KIRWAN, I.F.S., Deputy Conservator of Forests, and Instructor, Forest Research Institute and College, Dehra Dun, has been published as FOREST BULLETIN No. 35 of 1917 :—

INTRODUCTION.

The data, on which this note is based, are those collected by the Forest Economist, and consist chiefly of reports from Divisional Forest Officers, and extracts from works of reference, and from articles which have appeared from time to time in the INDIAN FORESTER. The subject will be dealt with under four heads :—I.—Distribution, II.—Silviculture and Managements, III.—Timber, and IV.—Minor Products. As the series of bulletins, of which this note forms a part, is designed to treat of forest trees, chiefly from a commercial point of view, the silviculture of the tree will be dealt with as shortly as possible.

I. DISTRIBUTION.

Babul is indigenous in Sind, Rajputana, Berar and the Central Provinces, Gujarat, and the North Deccan, but it is also cultivated and grown in the drier parts of India and, to a small extent, in Upper Burma.

It occurs as far north as Jammu, etc., where it is found at the lower elevations, especially near cultivated lands, and extends to the very south of the Peninsula. This does not mean that there are large Babul forests all over India. On the contrary, a large proportion of the growth occurs in Revenue lands in the form of small patches of isolated trees. The District Forest Officer, Guntur, Madras Presidency, for instance, states that "isolated trees are everywhere met with ;" and he estimates the Babul-bearing area in his district at 19,093 acres, of which only 4,817 acres are reserved forest —a state of affairs which must be typical of many Indian districts.

The only provinces in which Babul forests in any extent occur are Bombay (including Sind), Berar (Central Provinces) and Madras. By far the finest and most extensive forests are found in Sind which may, in fact, be termed the home of the Babul. The Hyderabad Division alone contains 90,000 acres of Babul forest and the Jerruck Division follows close with 80,000 acres. Several divisions of the Bombay Presidency proper contain fairly large tracts, notably Poona with 12,440 acres, and East Khandesh 4,220 acres. Three of the four Berar districts, namely, Amracti, Buldana and Akola also furnish substantial Babul-bearing tracts, while important tracts also occur in some Madras districts.

The following statement gives roughly the areas of Babul forest in the provinces above referred to :—

Bombay ...	Sind Circle	172,000 acres.
	Central Circle	22,000 ,,
Central Provinces	Berar	15,000 ,,
Madras ...	All Circles	77,000 ,,

It does not seem necessary to give detailed information regarding the numberless small areas of Babul occurring in the various Provinces. Enough has been said to indicate where the tree is at present growing on a commercial scale, and further details regarding its distribution would no doubt be gladly furnished by the Conservators of the various Circles.

II. SILVICULTURE AND MANAGEMENT.

(a) LOCALITY.

Babul is seen at its best on alluvial soil in riverain areas which are subject to annual inundation. The truth of this is very evident from an examination of the Sind Forests. These forests fringe the banks of the Indus, and areas which benefit by the inundation, and of which the soil is not too salty, produce excellent crops of Babul ; whereas areas which are too high or too far from the river to benefit from the inundation either bear no forest at all or forests of other species, such as *Prosopis spicigera*, in which Babul is largely or wholly absent.

Next to alluvian—black cotton soil is most favoured by the tree : Babul may, in fact, be said to be the tree most typical of black cotton soil areas. It is also very generally found growing in tank beds in cultivated land, and along ravines, and it is also a common road-side tree.

As a rule, Babul requires subsoil moisture to be near to the surface, as it is a shallow-rooted species, and it is no uncommon sight in Sind to see crops of Babul dying of drought, owing to the river having changed its course, thus depriving the trees of the moisture to which they had been accustomed. The tree is, however, satisfied with a very moderate rainfall, and can, of course, dispense with rainfall altogether if subject to annual inundation. Babul prefers very low elevations and rarely grows above 2,000 feet above sea-level.

(b) SHAPE AND DEVELOPMENT.

Babul is a small to moderate-sized tree with a large spreading crown and a comparatively short bole. Its dark brown bark is much fissured, its leaves are bipinnate, and its flowers, which appear in the rains in axiliary globose heads, are yellow and fragrant. A distinctive feature of the tree is its straight, white, sharply pointed spines which are often half an inch long and sometimes even longer. It is, generally speaking, a shallow-rooted tree and as such subject to danger from wind-fall. Although reliable figures are not available, Babul may be said to be a fast growing tree, at any rate during the first 20 years or so of its life. The Divisional Forest Officer, Hyderabad, Sind, states that in less than 5 years the tree, under favourable conditions of soil and moisture, attains a girth of 1½ feet at breast-height, while its average girth at 35 years is about 4 feet. It attains its highest development in Sind, where trees often reach a height of between 50 to 60 feet, with a clear bole

of 20 to 25 feet, in favourable localities, and where girths of from 8 to 10 feet are not uncommon. Berar and some of the Deccan divisions also contain well-developed Babul, but the height-growth is on an average considerably less than that in Sind; while in Madras the growth is much poorer, the height being rarely over 30 feet, and usually considerably less. The above remarks apply to localities suited to the tree; in unsuitable localities such, for instance, as stony shallow dry soils, the development is very poor, the tree having a stunted appearance and being of very slow growth.

It may here be stated, on information kindly supplied by the Forest Botanist, that the three following varieties of Babul are commonly recognized :—

(1) *Telia or Godi.* Bark blackish brown, slightly cracked, spines short, pod distinctly constricted between the seeds.

(2) *Kauria or Vedi.* Bark gray brown, deeply cracked, spines long, pods, very little constricted between the seeds.

(3) *Ramkanta Kabuli Kikar, Kikari,* a broom-like tree with close ascending branches, somewhat like a cypress.

In this note Babul is, however, treated as one species, the question of varieties being ignored because although the varieties are commonly recognized, their constancy and detailed botanical characteristics have not yet been finally determined, and consequently precise information regarding the distribution and relative economic importance of the different forms is not yet available. At the same time, it may be noted that BRANDIS states that the wood of Telia is prized while that of Kauria is only fit for firewood. The matter is, however, under study by the Forest Botanist.

(c) REPRODUCTION.

In localities favourable to the growth of Babul, the question of its regeneration presents little difficulty. Although natural regeneration is said to be excellent in some districts, yet it is generally found that to collect and sow seed which has passed through cattle, sheep or goats (which eat the pods greedily), gives the best results; or the animals may be fed on the pods and stalled on the area which it is wished to regenerate. The frequent failure of green seed to germinate is believed to be due to insect damage.

In favourable areas such, for instance, as the best Sind Forests it is quite sufficient to broadcast the seeds, but in localities which are not so suitable, sowing in pits and patches and on ridges and mounds have all been tried with more or less success. In places where broadcast sowing is not successful, however, some form of ploughing before sowing, where this is feasible, will usually give the best results. The area may be full ploughed, ploughed in single lines, or cross ploughed, and the seed broadcasted (in the case of full ploughing), or sown in the furrows; provided that the seed used has passed through cattle, this method should ensure success. The agri-silvicultural method of regenerating Babul has been tried with great success in various districts and especially in Berar. According to this method, Babul seedlings are raised with field crops, and thus obtain all the advantages of ploughing, while the latter is carried out without expense to the Department.

Many forest officers look on Babul as a non-coppicer, and it is a fact that, in most of the important forests, the tree is, for all practical purposes, a non-coppicer.

In several districts, however, among which may be mentioned several Madras districts, notably Anantapur and Guntur, the Jhansi district of the United Provinces, the Surat district of Bombay, and the Ajmer-Morwara district, the tree is said to coppice well, but it does not appear to send up good shoots after it has passed about 15 years of age.

It may here be mentioned that the tree pollards well. Young Babul seedlings are fairly hardy, and it is never necessary to raise them in a nursery. They suffer a good deal from frost in districts where this occurs, but more often than not, put out fresh shoots.

Another foe to young plantations is a Lamiid beetle, *Cælosterna Scabrata*, Fab., commonly known as the Babul root-boring longicorn. The Forest Zoologist states that this is a pest of the first importance, since it is capable of obtaining a complete mastery over a young plantation. It attacks the stems and roots of young plants, usually in the second or third year, and plants seriously attacked are certain to die. The Sind forest do not appear to suffer from the attacks of this insect, details of whose life-history together with instructions for preservative and remedial measures can be obtained from the Forest Zoologist.

(d) MANAGEMENT.

Seeing that Babul tends to form pure even-aged crops, and that the regeneration of the species, as has been explained above, usually presents no difficulty, the management of such forests is quite simple. Typically, the clear felling method, with a rotation of 30 or 40 years, followed by artificial regeneration, is applied, and this gives excellent results. In cases where the primary object of management is the production of bark for tanning purposes, the rotation should be much less, say 10 or 15 years.

In districts where the tree coppices well, the coppice-with-standards method has been adopted with varying success. Surat and Anantapur are examples of such districts, and the Guntur and Tinnevelly forests were also worked according to this method, for some years, on a 20-year rotation, but the treatment was found unsatisfactory, and abandoned in favour of selection fellings.

III. TIMBER.

(a) Description and Properties of the Wood.

Heart-wood and Sap-wood.

The heart-wood is pink, and turns reddish-brown on exposure, being mottled with dark streaks. It polishes well without absorbing much polish. The sap-wood is yellowish white in colour, and, in mature trees, forms a small proportion, say, less than 20 per cent. of the total volume. The annual rings are not very distinctly marked.

Durability.

The heart-wood is hard and very durable ; if well seasoned, it is tough and somewhat difficult to work. It is said to be not readily attacked by insects ; whereas the sap-wood is soft, is readily attacked by insects, and decays rapidly.

Weight.

The average weight of the timber is 54 lb. per cubic foot.

Strength.

The value of P., which represents the strength of a bar of timber, calculated from the length between supports, breadth, and thickness of the bar, and the weight in pounds, which, when placed in the middle of the bar, causes it to break, is from 875 (Cunningham) to 884 (Skinner). As the same co-efficient for teak is 600, for Sal 790, and for Shisham 796, it will be realized what a very strong wood Babul is.

Fissibility.

No experiments, as regards the fissibility of Babul timber, have yet been made.

CALORIFIC POWER.

The following table gives the calorific value of Babul charcoal and fuel :—

Charcoal prepared in.	Calorics.	Br. Thermal Unit.	Water evaporated at 212° F. by 1 lb. of charcoal or fuel.
(a) Open kilns	6,675	12,015	12·47
(b) Closed kilns	6,831	12,295	12·71
Fuel	4,814	8,665	8·95

SEASONING POWER.

The timber seasons well without much warping or splitting. Various methods of seasoning, such as immersing in water and burying in the ground, have been tried, but natural seasoning in the air seems to be quite satisfactory. The bark should be removed first in order to minimise the chances of insect damage, and large logs should be roughly squared.

(b) Felling and Extraction.

Babul coupes are, as a rule, sold standing to contractors, who usually fell small trees with the axe, and sometimes use the saw for larger ones. As the tree typically grows on comparatively level land, its extraction presents no difficulty ; carts or camels being the usual means employed in conjunction with carriage by boat, where, as in Sind, a suitable river is available.

(c) Size of Timber Obtainable.

The wood forms such an excellent fuel, and is, therefore, so extensively used for fire-wood that Babul forests are worked under a short rotation usually roundabout 30—40 years, which is long enough to produce the class

of material most in demand, such as, in addition to fuel, small timber pieces for agricultural implements and the like. The consequence is that the only large logs available (and many of these are unsound) are those cut from the old trees which are gradually being removed, and whose place will be filled by much smaller stuff. The supply of large Babul timber is thus being rapidly exhausted, and it is significant of this that, in discussing the uses to which the timber may be put, the Divisional Forest Officer, Jerruck (Sind), states that while his Division used to supply timber for the Gun Carriage Factory, timber of the necessary dimensions is not now available. Should, however, a supply of large Babul timber be required, there would be no difficulty in growing it, and selected areas could be set apart for that purpose.

(d) Outturn and Price.

It is not possible to give figures of outturn in any detail, as these are generally either not available or unimportant. The table on page 61 contains statistics supplied by the officers in charge of the divisions, in which the most important Babul-bearing areas are situated. These statistics are entered as received, and no attempt has been made to convert them to a uniform standard of measurement; they are merely intended to indicate roughly the quantities of Babul wood available from Government forests at these centres. No details are to hand as regards the outturn in Revenue lands, but it may be remarked that neither from forest nor from Revenue lands does there appear to be any appreciable quantity of timber available for export.

(e) Uses of Timber.

The timber is used chiefly for firewood, and a good deal of it is made into charcoal. It is also used for a large variety of agricultural and domestic purposes, such as the following:—Posts, rafters, beams, door-frames and other parts of houses, bodies of carts and carriages, yokes, axles, shafts, naves, spokes and felloes, solid wheels, boat-building, oars, sugar and oil-presses, rice-pounders, ploughs, harrows, clod-crushers, Persian wheels, well-curbs, cattle-yokes, tent-pegs, boat-handles, bed-steads, cooperage, packings of buffers of railway rolling-stock, carving and turning including carved dies for cloth-stamping, etc. The Divisional Forest Officer, Sukkur, states that it is used as pit-props in the Khost and coal-mines in Baluchistan.

As explained above, the timber was formerly used in the Gun Carriage Factory, and it has also been tried as a Railway sleeper wood, but in small quantities only. The sleepers are reported to have had a life of about ten years, if laid in places where they are not liable to attack by white-ants, and to have been supplied by contractors at the rate of Rs. 2-12-0 each. The Port Engineer, Karachi, states that in Karachi Babul sleepers, measuring about 10+10+5, "were laid down for the Port Trust yard railway lines, but as they were found to be subject to early destruction by white-ants their use was discontinued."

OUTTURN AND PRICES OF BABUL IN DIFFERENT LOCALITIES.

DIVISION	Outturn during last five years		Estimated future annual outturn		PRICE	REMARKS
	Timber	Fuel	Timber	Fuel		
Bombay and Sind						
Hyderabad	141,979 (c. ft.)	...	60,000 (c. ft.)	1,640,000 (c. ft.)	Average price of timber 0-11-0 per c. ft.	
Jerruck	150,058 (c. ft.)	...	31,611 (c. ft.)	...	Average price of timber 0-14-0 per c. ft.	Estimated outturn of fuel not stated.
Poona	1,777,980 (c. ft.)		300,000 (c. ft.)		Rs. 12·0 to Rs. 14·0 per Khandy of 20 maunds	Figures give gross outturn of timber and fuel.
Berar						
Amraoti	7,157 (tons)	...	1,450 (tons)	...	Rs. 17·0 per ton for split fuel	Figures probably include fuel.
Buldana	92,809 (c. ft.)	...	14,605 (c. ft.)	...	Rs. 10·0 per ton green Rs.13·0 per ton dry	Figures probably include fuel.
Akola	...	366,209 (c. ft.)	...	73,242	Rs. 9·0 to Rs. 15·0 per ton of fuel	Not sold as timber.
Madras						
Guntur	...	623,320	...	...	Rs. 15·0 to Rs. 20·0 per ton	No estimates of future outturn have been made.
Tinnevelly-Ramnad	9,000 (tons)	...	...	...	Rs. 10·0 to Rs. 14·0 per ton	Pieces useful for agricultural implements sell at higher rates.

IV. MINOR PRODUCTS.

(a) Leaves.

The leaves form a useful cattle-fodder and are sometimes farmed out, together with the pods, for the purpose. They also yield a dye.

(b) Pods.

The pods form an important item of cattle-fodder and the late MR. MCKENZIE, when he was Divisional Forest Officer of Jerruck, wrote that, in that Division, they were almost solely used for that purpose. He says: "the pods are sold annually as they stand on the trees. . . Cattle eat Babul pods in their green state, and, in years of very plentiful pod crops, the seed is sometimes stored, to be used as fodder at a later date, when their use is so postponed the pods are usually boiled before being given to the cattle."

In some divisions, the sale of pods for fodder forms an important item of revenue, but in others, notably in Madras, their collection is allowed free. The Divisional Forest Officer, Poona, writes that, in that division, the right to collect pods is sold with the condition attached that a proportion of the undigested seed is returned for sowing purposes; while the Divisional Forest Officer, Tinnevelly, states that though the collection of pods is now allowed free, they fetched as much as Rs. 6,800 per annum before the privilege was granted.

Babul pods also form a tanning and dyeing material, but MR. MCKENZIE writing from Jerruck stated that "they yield an inferior tan, Babul bark is preferred for this purpose." According to WATT'S COMMERCIAL PRODUCTS OF INDIA, "Babul pods impart a beautiful colour to leather, and mainly on that account enjoy a certain local reputation as a weak tanning and dyeing material, useful in conjunction with other substances. At the Cawnpore tanneries, the pods are employed almost exclusively for the purpose of removing the line from skins and hides, before the leather is tanned with Babul bark or other substances. The dyers of India often use Babul pods to obtain certain shades that are admired in calico printing."

The following is the result of an analysis of these pods made by the Technical College in 1913 :—

	Whole pod. Per cent.	Husk only Per cent.
Tanning matter absorbed by hide powder	12·6	21·0
Soluble non-tannin matter ...	15·4	25·6
Moisture	18·0	...
Insoluble	54·0	...
	100·0	

Since the seeds were said to form 40 per cent. and the bark 60 per cent. of the whole pod, it will be seen that according to this analysis, 60 per cent. of the bark contains 21 per cent. of tan.

(c) Gum.

The gum of *Acacia arabica* is an important minor product. It is not true gum arabic, which is obtained from *Acacia Senegal*, but is the Indian gum arabic of the commerce or "gum ghati." The gum exudes spontaneously,

or is procured by incisions in the bark in the form of small lumps varying in form and size. A good tree is stated to yield about 2 lb. of gum in a year. The gum is extensively used for calico printing and sizing paper, for fixing paint and white wash, as a mucilage, and to a limited extent in medicine. It is also eaten, and used in preparing sweet-meats. The price varies according to quality and colour ; large light coloured tears from Sind Babul fetch the highest prices, a fair average being about 4 annas per lb., while the fine qualities fetch as much as 8 annas per lb.

The gum is not, as a rule, collected departmentally, but by contractors as in Tinnevelley, and can generally be purchased in large bazaars. In the latter case, however, it will very likely be mixed with that of other species, for, as the Dictionary of Economic Products states, "the gum designated 'gum ghati' would embrace very possibly a wide range of gums (besides those obtained from species of Acacia), and very often it is believed degrees of quality must denote the extent of admixture rather than the nature of specific variation."

There is a considerable export trade in Indian gum arabic, and the latest figures available, those for the year 1913-14, show that 44,691 cwts. valued at £62,485, were exported from India to the United Kingdom and various foreign countries. Practically the whole of the amount came from Bombay.

(d) Bark.

Babul bark is used to some extent as a dye and, according to "Dyes and Tans of Bengal" by H. McCANN, the following is a recipe for dyeing cloth a dark brown colour :—

"For dyeing a yard of cloth, a pound of the bark is cut or broken into very small chips, and is boiled in about 5 lb. of water until about 3 lbs. of water remain. The solution is then allowed to cool. A pice weight of alum (about 1/5 oz.) is then pounded and mixed with the solution. The cloth to be dyed is washed in pure water, and the moisture well wrung out of it. It is then steeped in the above solution, and is afterwards put to dry in the shade. This steeping and drying is repeated two or three times."

It is, however, chiefly as a tanning agent that the bark of *Acacia arabica* is of value.

PROPERTIES.

Although Babul bark is a good tan bark, it is stated that it can only be used alone for certain purposes ; such as for the soles of boots, for it is a "harsh" bark, that is, it produces brittle leather. If, however, the bark of *Cassia auriculata* is added to the Babul bark this brittleness is overcome.

The following figures, from the analysis made by an English firm on raw hides sent home, are of interest as showing, in the case of Babul and other well-known tan bark trees, the amount of tannin matter absorbed by a hide, or, in other words, the percentage of tannin in the bark which can be utilized.

	Trunk bark. Per cent.	Twig bark. Per cent.
Acacia arabica	17·1	11·7
„ Leucophloea	15·6	5·8
Shorea robusta	8·2	9·0
Cassia auriculata	18·7	...
Terminalia Chebula	30·0	...

METHOD OF TANNING.

MR. PETHE, Extra-Assistant Conservator of Forests, Bombay, gives an interesting account of the method of tanning adopted in Poona, of which the following is the substance :—

The bark of the best or "Godi," variety of Babul only is used for tanning, and this bark is removed from the trees as soon as possible after felling, and before it has had time to dry up. The only instrument used for removing the bark is a wooden mallet which loosens it until it is easily stripped from the tree.

After removal the bark is allowed to dry, and is then beaten up into small pieces by the same mallet, it cannot be kept in this state for more than a year ; for if kept longer than this, it begins to lose its tanning colour. The prepared bark is then mixed with myrabolans, which have also been broken up into small pieces, in the proportion of 160 lb. of Babul bark to 100 lb. of myrabolans. The object of this mixture is stated to be to ensure a good colour, since if Babul bark alone is employed the resulting colour is deep yellow instead of brown.

A sufficient quantity of water (exact proportion not stated) is added to the mixture and into this preparation the skin to be tanned, which has already been soaked in lime for about 15 days, is dipped. It remains immersed for three or four days, and is then taken out and sewn into a sort of bag with aloe fibres. It is then filled with the same preparation and hung up for four or five days by the end of which time the tanning process is complete.

QUALITY OF BARK.

MR. PETHE states that bark from the branches, trunks and roots are all valued for tanning, but bark from the branches is the best. This does not agree with the analysis given above, in which trunk bark is shown to contain the largest percentage of tannin.

Probably MR. PETHE had in mind large trees with very thick trunk bark, for it is generally agreed that young trees yield the best bark for tanning purposes.

The late MR. C. S. MCKENZIE writing from Sind says : "although the quantity of tannin in the bark increases with the size and age of the tree, old bark yields a darker coloured tannin, and for this reason the barks of the younger trees and branches is preferred." MR. PETHE says : "young trees of 5 to 10 years old give the best bark for tanning."

In contrast with these statements, the author of an article entitled "Tannin Materials" in Volume XXI. of the TEXTILE JOURNAL writes : "the larger the tree, the greater the tannin contents of the bark become, and it also becomes a little darker in colour, and consequently in some districts, where Babul is very plentiful, the local tanners only use the bark of the larger branches, as they get a better coloured leather from this than the trunk bark."

Both MESSRS. GAMBLE and the author of the DICTIONARY OF ECONOMIC PRODUCTS, however, agree that eight to ten years would probably be the most profitable rotation under which to grow Babul for tanning purposes; and MESSRS. COOPER ALLEN AND COMPANY of Cawnpore, who probably have more experience in the matter than any other firm, state in a note on Babul planting drawn up by them, that "the best age for a tree from which bark is to be taken is ten years." Their opinion may be accepted as final.

OUTTURN AND PRICE.

That there is a large demand for Babul bark in India is evidenced by the fact that the Cawnpore tanneries alone are stated to consume 500,000 maunds annually, and, since the local supply is declining, the establishment of plantations within an economic radius of Cawnpore has been mooted.

It is also stated that in Hyderabad and Kotri, which are the chief centres of the bark trade in Sind, some 115,000 maunds of Babul bark are sold annually for tanning purposes and also for making country liquor.

It is exceedingly difficult to obtain any reliable figures regarding outturn and price; for Babul trees are, as a rule, sold standing to contractors, and the bark trade is therefore not in the hands of the Department. The Chief Conservator of Forests of the Central Provinces in 1913, however, gave it as his opinion that arrangements could be made to sell the bark separately, if necessary.

The price will obviously depend largely on the local labour supply and the distances from the Railway. Although no general figures can be quoted, the following statistics may be of interest:—

Forest Division	Amount of bark available annually (in maunds).	Cost of extraction to rail per maund.
Central Provinces.		Rs. A.P.
Amraoti	...	0 14 0
Akola	204	1 2 0
Buldana	1,400	1 12 0
Sind.		
Jerruck	15,000	0 12 0
Sukkur	300	0 0 0
Hyderabad	7,000 to 8,000	0 4 0 to 0 7 0

From an experiment carried out in the Berar Circle of the Central Province it was estimated that the cost of collection alone, without carriage to rail, or railway freight, would be Re. 0-10-6 per maund in the Amraoti Division, and Re. 0-13-8 per maund in the Akola Division.

In his "Forest Economic Products of India" published in 1912, MR. PEARSON states: "The prices vary in different localities from 10 annas to Rs. 1-4-0 per maund of 82 lb. In Cawnpore the ruling prices at present are from 13 to 14 annas per maund. WATT states that the bark fetches from 8 annas to Rs. 2-4-0 per 100 lb." No statistics collected since the publication of the above materially alter the statement quoted.

(e) Lac.

In conclusion, it may be stated that the Babul tree forms an excellent host tree for the lac insect, and the Sind Babul forests, particularly those of the Hyderabad Division, constitute one of the chief lac-producing areas of India.—INDIAN TRADE JOURNAL, NOV. 16, 1917.

THE EFFECT OF WEEDS UPON CEREAL CROPS.

WINIFRED E. BRENCHLEY.

The practical results of the competition of weeds and crops are well known, but the exact cause of this competition is less obvious. It is common knowledge that the weeds utilise food and water from the soil and, above ground, tend to rob the crop of much of the sunlight essential to full development. Apart from this, however, it has often been questioned whether the weeds may not excrete from their roots some poisonous substance which actually inhibits the growth of the crops, but the whole matter is very undecided.

The present paper gives the results of pot and water-culture experiments carried out at Rothamsted over a period of 4 years with crops and weeds grown in association. The following combinations were tested, the conditions being varied as far as possible to imitate natural conditions except that the pots were protected from birds.

The pots with wheat or weed alone received twice as much seed as was sown in the mixed pots; i.e. two parts of wheat or weed when alone and one part wheat + one part weed when mixed.

I. Pot Experiments. *Papaver Rhoeas* + *Papaver Rhoeas*, *Papaver Rhoeas* + *Wheat*, *Wheat* + *Wheat*, *Wheat* + *Alopecurus agrestis*, *Alopecurus agrestis* + *Alopecurus agrestis*, *Brassica alba* + *Brassica alba*, *Brassica alba* + *Wheat*, *Wheat* + *Spergula arvensis*, *Spergula arvensis* + *Spergula arvensis*.

II. Water culture Experiments. Wheat + *Spergula arvensis*, Wheat + *Alopecurus agrestis*.

The conditions and results of the various experiments are set out in detail, the total dry weights of the resulting crops of cereal and weed being given in each case. The conclusions are as follows:

There is no evidence, and indeed no indication, that any direct toxic action comes into play,

It is evident that the mere competition of plant with plant, irrespective of species, has much to do with development and that the time and duration of competitive check are the chief factors involved. Purely vegetative competition is more potent than is generally realised. In the experiment all the crop plants were at least 4 or 5 inches apart, and the effects of overcrowding were most obvious. In a field where weeds are at all prevalent, the plants are still more closely placed, and the struggle must be still keener. Even when the weeds are suppressed by cultivating and hoeing, the roots remain in the soil to a large extent, and those of the perennials at least continue functioning in a normal way, though to a less degree; nevertheless, such suppression of weeds is all to the advantage of the crop, owing to the removal of the aerial competition.

The vital factor in competition is the mere presence of other plants, be they what they may, and, up to a certain limit, two plants cannot make such good individual growth in a given restricted area as can one plant.

In those cases where the same soil was allowed to serve for experiments in successive years a comparison of the dry weights, pot for pot, did not show any evidence that the crop obtained from any individual pot in the first year in any way affected that obtained in the year following. This is a further proof of the absence of toxic effects from the roots. If toxins had been present a pot which carried a relatively small crop in 1915 might have been expected to carry a relatively large one in 1916 and vice-versa, as the large crop would have left a larger supply of toxin in the soil. As no such correlation was proved it seems evident that no toxin capable of remaining unchanged from one season to the other was present in the soils.—BULL. INTERNAT. INST. OF AGRIC., YEAR VIII NO. 7. JULY 1917.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31st DECEMBER, 1917.

Province.	Disease.	No. of cases to date since Jan. 1st, 1917.	Fresh cases during the month	Recoveries.	Deaths.	Balance ill.	No. shot.
Western	Rinderpest	675	26	118	528	2	27
	Foot & mouth disease	737	52	735	2	—	—
Colombo Municipality	Rinderpest	805	—	—	—	—	—
	Anthrax	5	—	—	—	—	—
	Foot & mouth disease	344	—	—	—	—	—
	Rabies	51	1	—	—	—	—
Quarantine Station	Anthrax	331	146	—	—	—	—
	Foot & mouth disease	10	—	—	—	—	—
	Rinderpest	1	1	—	—	—	—
Central	Rinderpest	85	—	27	52	—	6
	Anthrax	33	—	—	26	—	7
	Foot & mouth disease	401	—	398	—	3	—
Northern	Foot & mouth disease	155	—	151	4	—	—
	Anthrax	22	—	—	22	—	—
North-Western	Rinderpest	408	72	99	229	6	4
	Foot & mouth disease	1195	2	1191	1	2	1
	Rabies	1	—	—	1	—	—
Eastern	Foot & mouth disease	944	1	916	19	—	9
Sabaragamuwa	Rinderpest	49	1	7	35	—	7
	Foot & mouth disease	526	—	526	—	—	—
	Rabies	1	—	—	1	—	—
Uva	Rinderpest	33	5	8	19	—	6
	Foot & mouth disease	925	—	899	26	—	—
North-Central	Foot & mouth disease	1858	318	950	13	895	—
Southern	Rinderpest	20	—	—	11	—	9
	Foot & mouth disease	37	—	37	—	—	—
	Anthrax	7	7	—	7	—	—
	Rabies	2	—	—	2	—	—

G. W. STURGESS, G.V.S.

METEOROLOGICAL.

DECEMBER, 1917.

Station.	Temperature: Mean Daily Shade	Temperature: Difference from average	Mean Humidity	Mean amount of cloud 0=clear, 10=Overcast	Mean Wind direction during month	Daily mean Velocity	Rainfall: Amount	Rainfall: No. of Rainy days	Rainfall: Difference from average
	°	°	%			Miles	Inches		Inches
Colombo Observatory	77·6	-1·4	80	5·3	N	112	4·30	9	+0·02
Puttalam	76·2	-1·4	84	4·8	NNE	86	4·23	9	-2·01
Mannar	78·3	-0·7	77	6·7	N	170	5·46	12	-2·08
Jaffna	76·7	-0·9	82	5·5	NNE	80	4·99	9	-5·89
Trinco'mee	Return not received								
Batticaloa	77·3	-0·7	82	5·8	N	122	14·93	14	-1·71
Hambantota	77·2	-1·3	84	5·1	Variable	173	8·13	13	+2·61
Galle	77·5	-1·0	83	6·4	NW	114	3·71	12	-2·94
Ratnapura	78·4	-1·1	78	6·2	—	—	6·86	11	-2·08
Anu'pura	77·0	-0·1	80	6·6	—	—	5·30	12	-4·14
Kurunegala	76·8	-2·5	76	7·0	—	—	2·41	10	-5·33
Kandy	73·8	-0·7	74	6·6	—	—	5·13	14	-4·07
Badulla	69·8	-1·1	82	7·3	—	—	7·94	21	-4·85
Diyatalawa	64·4	-0.6	79	8·2	—	—	6·67	20	-1·67
Hakgala	57·0	-0·9	86	8·4	—	—	10·06	20	-3·95
N'Eliya	57·8	+ 1·1	78	7·3	—	—	3·63	10	-5·22

Cyclonic storms, of slight intensity, in the vicinity of the Island influenced the weather for the greater part of the month.

Only during the last week was the weather consistently fine and bright.

Air pressure, mean shade temperature and humidity were mostly below normal and the cloud amount was greater than usual, especially inland.

The rainfall for the month was mostly below normal, the South central portion of the Island alone showing a decided excess over normal.

J. E. EVANS,
Acting Supdt, Observatory.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	Quotations.
ALOES, Soccotrine cwt.	Fair to fine	95/ a 100/
Zanzibar & Hepatic „	Common to good	40/ a 105/
ARROWROOT (Natal) lb.	Fair to fine	7d a 8d
BEES' WAX cwt.		
Zanzibar Yellow „	Slightly drossy to good	£9 10/ a £9 15/
East Indian bleached „	Fair to good	£11 12/6 a £12
„ unbleached „	Dark to good genuine	£9 5s £9 10/
Madagascar „	Dark to good palish	£9 5/ a £9 15/
CAMPHOR, Japan lb.	Refined	3/6 a 4/3
China cwt.	Fair average quality	Nominal
CARDAMOMS, Tuticorin	Good to fine bold	3/6 a 4/6 nom.
per lb.	Middling lean	2, a 2/9 „
Malabar, Tellicherry „	Good to fine bold	3/ a 4/ „
Calicut „	Brownish	1/9 a 2/6 „
Mangalore „	Med Brown to good bold	2/6 a 3/3 „
Ceylon, Mysore „	Small fair to fine plump	2, a 5/
Malabar „	Fair to good	1/7 a 1/8
Seeds, E. I. & Ceylon „	Fair to good	2/ a 2/3
Ceylon "Long Wild" „	Shelly to good	1/ a 1/6 nom
CHILLIES, Zanzibar cwt.	Dull to fine bright	75/ a 85/
Japan „	Fair bright small	60/ a 70/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜d a 7d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¾d a 4¼d
	Renewed	3d a 5¼d
	Root	1¾d a 4d
CINNAMON, Ceylon 1sts.	Fair to stout quill	2/6
per lb. 2nds.	„ „	2/3
3rds.	„ „	2/
4ths.	„ „	11d
Chips,	Fair to fine bold	10½d a 1/
CLOVES, Penang lb.	Dull to fine bright pkd.	3/6 a 4/
Amboyna „	Dull to fine	2/ a 2/6
Zanzibar „	Fair and fine bright	1/9 a 1/10
Madagascar „	Fair	1/9 a 1/10
Stems „	Fair	7½d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian „	Fair to bold	„
COCOA, Ceylon Plant. „	Special Marks	87/ a 90/
	Red to good	80/ a 88/
Native Estate „	Ordinary to red	50/ a 76/
Java „	Small to good red	70/ a 96/
COLOMBO ROOT „	Middling to good	100/ a 120/
CROTON SEEDS, sifted„	Dull to fair	70/ a 75/
CUBEBS „	Ord. stalky to good	£16/ a £18/
FIBRE, Kitul lb.	OOO good long	10d a 11d
	OO „ medium	8½d
	No. 1 fair	7d
Palmyrah ton.	Common to fair	£30/ a £35 nom.
„	Medium to good med	£40/ a £45 „
	Good to fine	£50/ a £60 „
GINGER, Bengal, rough cwt.	Fair	62/6
Calicut, Cut A „	Medium to fine bold	100/ a 110/
B & C „	Small and medium	90/ a 100
Cochin, Rough „	Common to fine bold	67/6 a 72/6
	Small and D's	67/6
Japan „	Unsplit	50/ a 52/6
GUM Ammoniacum „	Ord. blocky to fair clean	175/ a 200 nom.
Animi, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
„	„ little red	£11 a £12
„	Bean and Pea size ditto	70/ a £11
„	Fair to good red sorts	£8 10/ a £10 10/
„	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar „	Fair to good palish	£4 a £8
„	„ red	£4 a £7
Arabic, E. I. & Aden „	Ordinary to good pale	55/ a 75/
Turkey sorts „	... ...	85/ a 87/6
Ghatti „	Sorts to fine pale	30/ a 50/
Kurrachee „	Reddish to good pale	35/ a 50/ nom.
Madras „	Dark to fine pale	30/ a 45/ nom.
Assafœtida „	Clean fr. to gd. almonds	£15 a £20
	com. stony to good block	£4 a £10
INDIGO, E.I. Bengal lb.	Shipping mid. to gd. violet	10/ a 13/
„	Consuming mid. to gd.	9/ a 10/
„	Ordinary to middling	8/6 a 9/6
„	Mid. to fine Kurpah	7/ a 9/
„	Low to ordinary	5/ a 6/9
„	Mid. to fine Madras	2/6 a 4/6
KAPOK-Ceylon lb.	Ordinary to good	1/ a 1/4
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	170/ a 200/
Somali „	„ „	140/ a 160/
MACE, Bombay & Penang per lb.		
	Pale reddish to fine	3/6 a 4/
	Ordinary to fair	3/ a 3/6
Java	„ „ good pale	3/6 a 4/
Bombay	Wild	8d

	QUALITY.	Quotations.
NUTMEGS,— lb.		
Singapore & Penang „	64's to 57's	2/ a 2 6
	80's	1/11
	110's	1/6
NUX VOMICA, Cochin	Ordinary to good	42/6 a 45/
per cwt. Bengal	„ „	35/ a 40/
Madras	„ „	37/6 a 42 6
OIL OF ANISEED lb.	Fair merchantable	4/3
CASSIA „	According to analysis	6/ a 6/3
LEMONGRASS oz.	Good flavour & colour	5d
NUTMEG „	Dingy to white	1½d a 1⅝d
CINNAMON (Ceylon)	Ordinary to fair sweet	6d a 2s
CITRONELLE „ lb.	Bright & good flavour	2/4
OLIBANUM, drop cwt	Good to fine white	130/ a 150/
„	Middling to fair	100/ a 120
pickings „	Low to good pale	22/6 a 40/
siftings „	Slightly foul to fine	35/ a 45/
ORCHELLA WEED—cwt		
Ceylon „	Fair	10/6
Madagascar „	Fair	10/6
Zanzibar „	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	1/3 a 1/3½
Ceylon „ „	Fair to fine bold heavy	1/2 a 1/4
Singapore ...	Fair	1/2⅜
Acheen & W. C. Penang	Dull to fine	1/2
(White) Singapore „	Fair to fine	1/8
Siam „	Fair	1/8½
Penang „	Fair	none
Muntok „	Fair	1/8½
RHUBARB, Shenzi „	Ordinary to good	1/4 a 3/
Canton „	Ordinary to good	1/3 a 2/6
High Dried„	Fair to fine flat	1/7 a 1/9
RUBBER, INDIA lb.	Standard smoked sheets	2/4½
Ceylon, Straits, „	Standard Crepe	2/5½
Malay Straits, etc. „	Scrap fair to fine	1/8
Assam „	Fair 11 to ord. red No. 1.	1/4
Rangoon „	„ „ „	1/6
Borneo „	Common to good	1/6
Java „	Good to fine red	1/8 a 1/10
Penang „	Low white to prime red	1/6 a 1/9
Mozambique „	Sausage, fair to good	1/6 a 2/
Nyassaland „	Fair to fine ball	1/6 a 2/
Madagascar „	Fr. to fine pinky & white	1/4 a 1/7
„	Majunga & blk coated	1/
„	Niggers, low to good	9d a 1/6
New Guinea „	Ordinary to fine ball	1/6 a 2/
SAGO, PEARL, large—cwt	Fair to fine	50/ a 65/
medium ...	„ „	50/ a 65/
small ...	„ „	50/ a 65/
Flour ...	Good pinky to white	40 a 77/6
SEEDLAC cwt.	Ordinary to gd. soluble	225/ a 250/ nom.
SENNA, Tinnevelly lb.	Good to fine bold green	10d a 11d
	Fair greenish	6½d a 9d
	Common specky & small	3½d a 5½d
SHELLS, M. of PEARL—		
Egyptian cwt.	Small to bold	40/ a £5 10/ nom
Bombay „	„ „	55/ a £5 15/ „
Mergui „	Chicken to bold	£6 15/ a £10 15/
Manilla „	„ „	£6 a £10/ nom
Banda „	Sorts	40/ a 45/ „
Green Snail „	Small to large	50/ a 75/ „
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	45/ a 50/
per cwt. Madras	Inferior to good	25/ a 35/
TORTOISE SHELL—		
Zanzibar & Bombay lb.	Small to bold	10/ a 25/
	Pickings	5/ a 15/
Ceylon	Small to bold	10/ a 22/
Mauritius & Seychelles	„ „	10/ a 25/
TURMERIC, Bengal cwt.	Fair	50/
Madras „	Finger fair to fine bold	55/ a 60/
Do. „	Bulbs „ „ bright	45/ nom.
Cochin „	Finger fair	50/ nom.
	Bulbs „	37/6
VANILLA,— lb.		
Mauritius ... } 1sts.	Gd. crystallized 3½a 8½ in.	5/6 a 9/6
Madagascar ... } 2nds.	Foxy & reddish 3½a „	5/ a 7/
Seychelles ... } 3rds	Lean and inferior	5/ a 5/9
WAX, Japan, squares, cwt.	Good white hard	92/5